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ENVIRONMENTAL WORKING PAPER

# MAINTENANCE OF REDWOOD CITY HARBOR, ALTERNATIVES FOR DISPOSAL;

Redwood City - Harbor
Dredging - California - Redwood City



U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
April 1978

# ERRATA SHEET

"Cedra Properties, Inc." should be replaced by "Bay Properties, Inc." wherever it appears in this working paper.

DEPARTMENT OF THE ARMY
SAN FRANCISCO DISTRICT, CORPS OF ENGINEERS
211 MAIN STREET
SAN FRANCISCO, CALIFORNIA 94105

8 MAY 1978

SPNED-E

TO ALL INTERESTED PARTIES:

Inclosed is the Environmental Working Paper for the maintenance of Redwood City Harbor which addresses alternatives for the disposal of dredged material. The Working Paper is being distributed to interested Federal, State and local agencies, citizens' groups and individuals for informal, working level review and comment. Information derived from this review process will be influential in the planning process and in the preparation of a Draft Environmental Statement, if required.

An Environmental Working Paper is a first step toward preparation of the Environmental Statement required by the National Environmental Policy Act of 1969 (Public Law 91-190). Its purpose is to obtain information by providing an opportunity for input by all interested parties, public and private, relatively early in the planning process.

If you have any comments on this Environmental Working Paper, please mail them to the Environmental Branch, at the address below:

U.S. Army Engineer District, San Francisco
Environmental Branch, Room 809
211 Main Street
San Francisco, CA 94105

Comments should be received within 30 days from the date of this letter.

Sincerely yours,

Karl F. Schmid LTC CE

1 Inclosure
As stated

for JOHN M. ADSIT
Colonel, CE
District Engineer

TABLE 8

DISPLAY OF FEDERAL COSTS AND CAPACITIES

| ALTERNATIVES | CAPACITY (Cubic Yards) | COST PER CUBIC YARD (Dollars) Hopper Dredge "Harding/Biddle"1/ | Clamshell & Barge | Hydraulic Pipeline |
|---|---|---|---|---|
| No Action | | | | |
| Aquatic Disposal Sites | | | | |
| South Bay Disposal Site | NA | $ .74/1.15 | $1.70 | NA 2/ |
| Hunter's Point Disposal Site | NA | 1.82/2.34 | 2.26 | NA |
| Alcatraz Disposal Site | NA | 2.52/3.37 | 2.62 | NA |
| Land Disposal Sites | | | | |
| Bair Island - Port of Redwood City Site | 370,000 | NA | NA | $2.23 3/ |
| Bair Island - Cedra Properties Site | 352,000 | NA | NA | 2.24 |
| Leslie Salt Company's Wash Pond and Salt Stack Site | 326,000 | NA | NA | 2.39 |
| Leslie Salt Company's Evaporator Pond Site | 4,654,000 | NA | NA | 2.01 |
| Ideal Basic Industries Site | 296,000 | NA | NA | 2.35 |
| Marsh Creation Alternatives | | | | |
| Leslie Salt Company's Evaporation Pond Site | 1,844,000 | NA | NA | 2.01 |
| California Wildlife Management Area Site | 1,690,000 | NA | NA | 2.27 |

1/ The "Harding" and "Biddle" are different Corps dredges which could be utilized.

2/ NA = Not Applicable

3/ The cost of land disposal sites does not include any local costs, such as dike construction or the purchase of lands.

# ENVIRONMENTAL WORKING PAPER

## MAINTENANCE OF
## REDWOOD CITY HARBOR
## ALTERNATIVES FOR DISPOSAL

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# SECTION 1

# INTRODUCTION

## A. PURPOSE OF ENVIRONMENTAL WORKING PAPER

This working paper is the first step towards assuring that environmental considerations are incorporated into the Corps of Engineers' planning process as required by Public Law 91-190, the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. Sec. 4321 et sec. It should be noted here that a working paper is not an environmental statement but merely a first step in the environmental statement process. The purpose of a working paper is to establish early coordination with governmental agencies, environmental organizations, citizens' groups, and the general public by giving them the opportunity to comment early in the planning process. Such early coordination with sources outside the Corps of Engineers is an essential element in the evaluation of alternative plans of action, and in the identification of significant impacts which may require further description in any future environmental statement, should one be required.

This working paper describes the environmental profile of the study area, discusses an array of alternatives for the disposal of dredged material, identifies the general impacts associated with each alternative, and presents a preliminary evaluation of the alternatives. The primary purpose of the working paper is to obtain information from those who review it.

## B. AUTHORIZATION

The Redwood City Harbor channel was first authorized under the Rivers and Harbors Act of 5 July 1884 and 13 June 1902. The existing harbor improvements were continued under authorization of Rivers and Harbors Documents dated 25 June 1910, 3 July 1930, 30 August 1935, 2 March 1945 and 17 May 1950. The existing project was completed in 1965.

The local sponsor of the Redwood City Harbor project, the Port of Redwood City, is responsible for providing adequate disposal sites for maintenance dredging of the channel.

## C. DESCRIPTION OF EXISTING PROJECT

The existing project dimensions include a channel 500 feet wide, 30 feet deep across San Bruno Shoal in San Francisco Bay, a channel 300 feet wide and 30 feet deep to the confluence of Westpoint Slough and

Redwood Creek; a turning basin (No. 1) at that location, 2,200 feet long and from 400 to 900 feet wide; thence a channel 400 feet wide, 30 feet deep and about 1,300 feet long to Turning Basin No. 2. The second turning basin is about 900 feet wide, 1,700 feet long and 30 feet deep. From there, a channel 150 feet wide and 5 feet deep extends to Steinberger Slough. Plate 1 shows the existing navigation channels and turning basins.

Historically, the Redwood City Harbor project has been dredged almost annually between 1931 and 1971. Table 1 gives a summary of the dredging history. San Bruno Shoal is not dredged and is considered an inactive part of the Redwood City Harbor project.

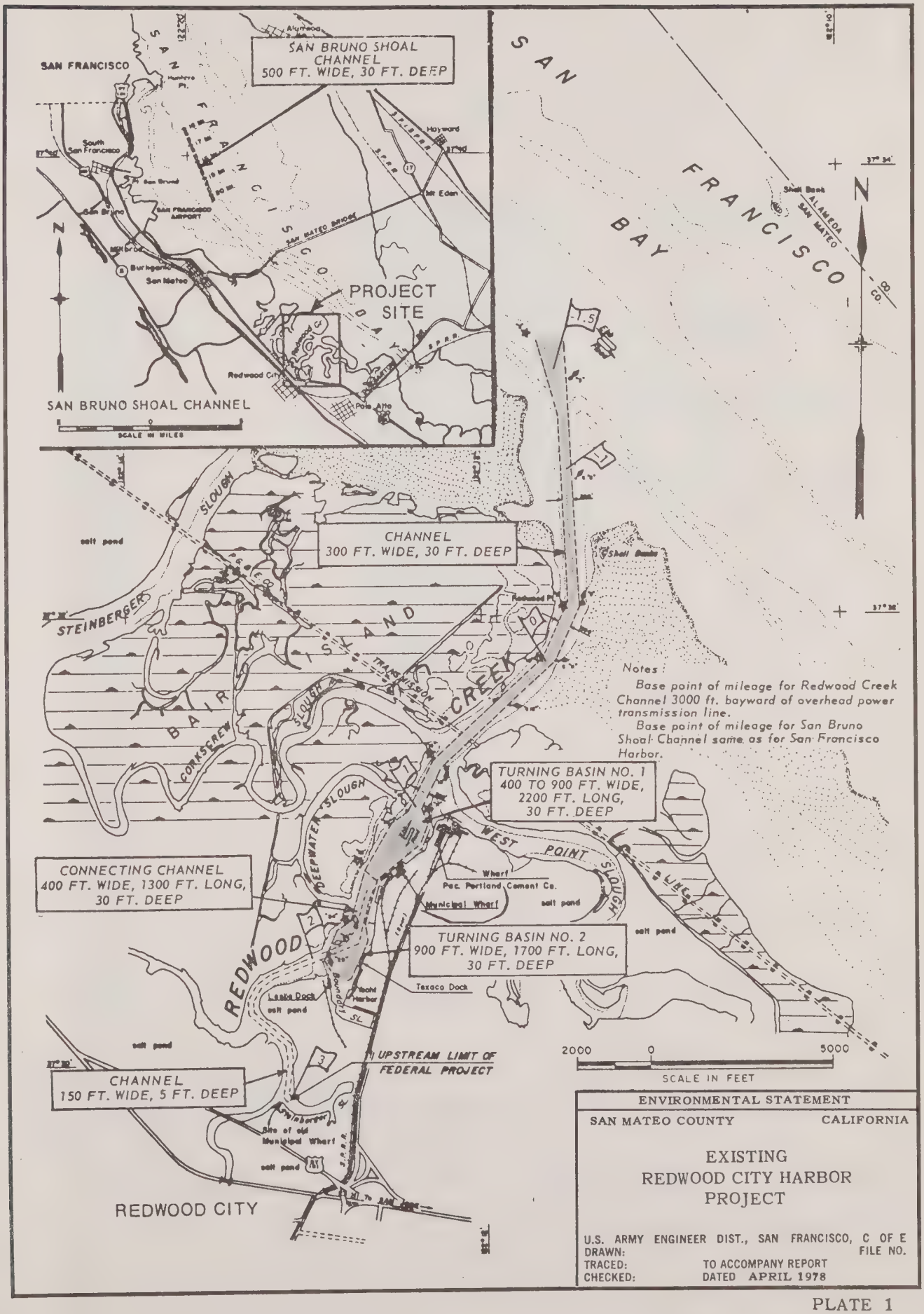
An estimated 500,000 cubic yards (c.y.) of dredged material will require removal from the Redwood City Harbor channel every 4 years. The date of the next maintenance dredging is tentatively scheduled for 1981. The total amount of material which will require disposal during the next 50 year period is estimated to be over 6,000,000 c.y.

The Economics Section of the San Francisco District, Corps of Engineers, analyzed the need for maintenance dredging in the Redwood City Harbor Project in 1977. This study, included as Appendix A, concludes that the Port is in a "transition" period at present. The following is a summary of this study. The Ideal Basic Industries, Inc., Hubbard Lumber Company and the Leslie Salt Company have either phased out their operations or are in the process of phasing out their operations in the study area. However, Texaco, Inc., a tenant of the Port of Redwood City, plans to expand its activity at the Port. The Port also has plans to improve and join some of their wharves.

Total commercial tonnage for the Port of Redwood City in 1975 was 575,800 short tons. By 1980, this figure is expected to increase to 900,000 short tons. Maintenance dredging for the Redwood City Harbor project therefore appears to be economically justified.

D. COMPOSITE ENVIRONMENTAL STATEMENT

The proposed maintenance dredging of the Redwood City Harbor channel was described in the Final Composite Environmental Statement for Maintenance Dredging, Existing Navigation Projects, San Francisco Bay Region, California, hereafter referred to as the Composite Statement (1). The proposed action, as described in the Composite Statement, included deposition of the dredged material in a suitable land disposal site. A proposed land disposal site was not addressed in the Composite Statement. Therefore, a supplement to the Composite Statement would be prepared.




ENVIRONMENTAL STATEMENT

SAN MATEO COUNTY CALIFORNIA

# EXISTING REDWOOD CITY HARBOR PROJECT

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN: FILE NO.
TRACED: TO ACCOMPANY REPORT
CHECKED: DATED APRIL 1978

PLATE 1

TABLE 1

DREDGING HISTORY OF REDWOOD CITY HARBOR PROJECT *

| Fiscal Year | Quantity Removed (c.y.) | | Method of Dredging |
|---|---|---|---|
| 1931* | 611,600 | | Hydraulic Pipeline – (and |
| 1937* | 1,266,700 | 1,878,300 | " " |
| 1938* | 730,900 | 2,609,200 | " " |
| 1939 | 10,000 | 2,619,200 | Clamshell |
| 1940 | 467,200 | 3,086,400 | Hopper |
| 1941 | 66,700 | 3,153,100 | " |
| 1942 | 701,400 | 3,854,500 | " |
| 1945 | 188,800 | 4,043,300 | Hydraulic Pipeline – |
| 1947 | 315,700 | 4,359,000 | Hopper |
| 1948 | 707,800 | 5,076,800 | " |
| 1949 | 445,800 | 5,522,600 | " |
| 1950 | 123,600 | 5,656,200 | Hydraulic Pipeline |
| 1951 | 331,300 | 5,987,500 | Hopper |
| 1953 | 360,900 | 6,348,400 | " |
| 1954 | 62,900 | 6,411,300 | " |
| 1955 | 199,200 | 6,610,500 | " |
| 1956 | 389,500 | 7,000,000 | " |
| 1957 | 158,000 | 7,158,000 | " |
| 1958 | 99,000 | 7257,000 | " |
| 1959 | 268,000 | 7,525,000 | " |
| 1960 | 68,700 | 7,593,700 | Hydraulic Pipeline |
| 1961 | 431,900 | 8,025,600 | " " |
| 1962 | 773,000 | 8,798,600 | Hopper |
| 1964 | 444,100 | 9,242,700 | " |
| 1965 | 295,200 | 9,537,900 | " |
| 1966 | 910,500 | 10,448,400 | " |
| 1967 | 379,100 | 10,827,500 | " |
| 1968 | 312,600 | 11,140,100 | " |
| 1969 | 201,000 | ~~11,341,100~~ | " |
| 1969 | 323,500 | 11,664,600 | " |
| 1970 | 639,000 | 12,303,600 | " |
| 1971 | 816,100 | 13,119,700 | " |
| 1972 | 0 | | " |
| 1973 1/ | 5,000 | | " |
| 1974 | 0 | | " |

* Includes improvement work.

1/ Experimental dredging operation related to Dredge Disposal Study.

SOURCE: Corps of Engineers, 1975 (1)

* Annual average 1931-1974 = 305,000 cy.
= (222,000 cy since 1945)

E. SECTION 10/404 PERMIT

The Port of Redwood City applied to the Corps of Engineers for a permit, required under Section 404 of the Federal Water Pollution Control Act of 1972 and Section 10 of the River and Harbor Act of 1899, to construct a levee on their Bair Island Property, located on the western side of Redwood Creek, opposite the Port facilities. The purpose of the proposed levee was to retain dredged material generated by maintaining the existing navigation project. Public Notice No. 74-0-78 identifies this permit request.

A draft Environmental Statement (ES) for this permit was filed with the Council on Environmental Quality on 7 August 1975. Due to objections received on the Draft ES, the Port modified its application to include only the levee. Use of the land within the levee was no longer considered for disposal of dredged material. This revision resulted in the issuance of a revised Public Notice, No. 9390-41, on 11 November 1976.

Various agencies have objected to both proposed activities. The U.S. Fish and Wildlife Service has objections to placing dredged material on wetland areas on this site. The San Francisco Bay Conservation and Development Commission (BCDC) refuses to accept a permit application prior to knowledge of the applicant's long-range plans for future development.

On 27 February 1978, the San Francisco District denied the Port's permit application. The denial was based on the following reasons:

a. There is no adopted, comprehensive land use plan for the Port of Redwood City; in particular, there is no organized, adopted plan for the future use of the Port's Bair Island property proposed to be diked.

b. Necessary State authorizations have not yet been obtained, such as a San Francisco Bay Conservation and Development Commission (BCDC) permit and a Regional Water Quality Control Board, San Francisco Bay Region, certificate of conformance with water quality standards. BCDC has indicated to the Corps that the proposed levee does not conform to the provisions of the McAteer-Petris Act and the San Francisco Bay Plan.

c. There appear to be important wetland, fish and wildlife values on the portion of Bair Island proposed to be diked, especially the area presently subject to tidal inundation.

d. The objections and concerns of the U.S. Fish and Wildlife Service, California Department of Fish and Game, The California Waterfowl Association and the Sequoia Audubon Society remain unresolved. They have urged the Port to modify the proposal to eliminate or mitigate any damage to the wetland, fish and wildlife resources. The Port has not effectively responded to their comments.

e. Since viable wetlands are involved, the Port is obligated to provide the Corps with sufficient information on the need to locate the proposed activity in a wetland and must provide data on the basis of which the availability of feasible alternative sites can be evaluated (33 CFR 320.4(b)(4) and 40 CFR 230.5(b)(8)). Since the Port has not provided the Corps with an adopted future land use plan for this area, it is not possible to evaluate feasible or practical alternatives in accordance with the Corps' public interest review (33 CFR 320.4(a)).

According to the Port of Redwood City, their application for a permit to dike their Bair Island property to preclude further tidal inundation is totally unrelated to their quest for a suitable land disposal site to contain dredged sediments from the Federal navigation Channel. The Bair Island property has been considered as a possible dredged material disposal site in the past by the Port, and they may consider it again if they obtain a permit to construct the proposed levee. Since the maintenance of the Channel is unrelated to the recently denied permit application, the denial of this permit would not affect the availability of the site for dredged material disposal. This alternative is therefore included in this working paper.

## SECTION 2

## ENVIRONMENTAL PROFILE

### A. INTRODUCTION

#### 1. Purpose.

The purpose of the environmental profile is to portray existing conditions by describing the relevant physical, biological, economic, and social characteristics of the affected area. It also extends the description of existing conditions to portray future conditions without any proposed action. The description of existing conditions is used in making projections of the "with action" conditions for each alternative being considered and these projections are then compared to the projection of "without action" conditions. At the present stage in the planning process, a tentative environmental profile is prepared. As specific alternatives are considered in greater detail, the profile would be made more precise and will focus on identified significant impacts.

#### 2. Definition of Study Area.

The study area is the area in which the alternatives under consideration would have an impact. In this working paper, the alternative plans include both land and aquatic disposal sites for dredged material. Thus, the study area includes land areas on both sides of Redwood Creek as well as the areas comprising each of the alternative aquatic disposal sites. More specifically, the land portion of the study area includes all of Bair Island, the lands owned by the Port of Redwood City and Ideal Basic Industries along the eastern shore of Redwood Creek, and the Leslie Salt Company's ponds, stretching as far as Flood Slough to the east. The location of Redwood City Harbor is shown on Plates 1 and 2, and the land portion of the study area is shown on Plate 3. Plate 4 shows land ownership in the study area.

The three aquatic disposal sites: South Bay, Hunter's Point, and Alcatraz, comprise 3 separate additions to the study area. The study area for the South Bay disposal site comprises an area 1,500 by 3,000 feet in size, just south of the San Mateo-Hayward Bridge. The study areas for the Hunter's Point and Alcatraz sites have a circular shape, with a diameter of 2,000 feet. For more information on the aquatic disposal sites, refer to Section 3, C. These sites are shown on Plate 2 (1).

## B. PHYSICAL ENVIRONMENT

### 1. Topography.

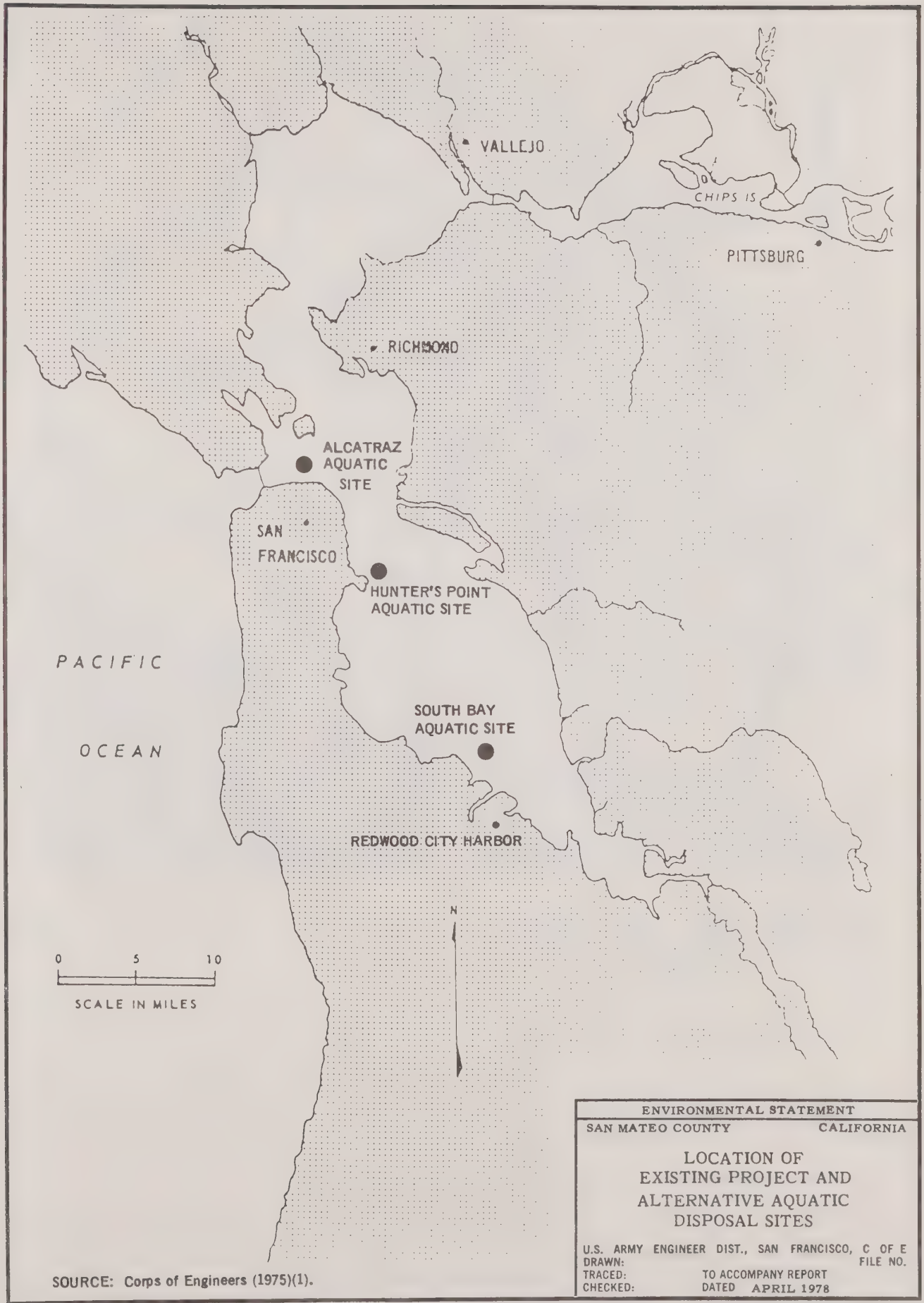
The study area is characterized by fairly flat terrain that slopes gently towards the San Francisco Bay. Much of the study area was once part of the Bay tidelands. Most of the lands within the study are saltponds that are presently being used or are abandoned. The salt ponds are surrounded by dikes that are generally several feet above MHHW. Portions of the marshlands in the study area have been partially filled with dredged material. The Cedra and Port of Redwood City properties on Bair Island have experienced fill to a varying degree along Redwood Creek. The only prominent topographic feature in the study area is the Leslie Salt Company's salt stack, located adjacent to Redwood Creek and southwest of the Port of Redwood City's facilities.

### 2. Geologic Hazards.

The soils of the study area consist predominantly of Bay muds, fine silts and clays. Similar soils are found on the San Bruno Shoals and have been deposited during earlier dredging projects in some of the proposed disposal areas. Interstitial water content, except for the soils in developed areas, is high and the stability of the soils is generally low (2).

There are two conditions which contribute to the lowering of the ground surface in the vicinity of Redwood City: subsidence and settlement. Subsidence is generally a lowering of the ground surface because of reductions in fluid pressures. Subsidence has been occurring in the Port of Redwood City since the mid-1920's. This has created a bowl which is centered over the ground water well field of the Ideal Basic Industries' property, located southeast across Redwood Creek from Bair Island. Studies over the years in this area show that the area has settled from 1.5 to 2 feet since the mid 1920's. The 1972 rate of subsidence in the bowl was about 1-1/2 inches in its center. This translates to approximately 3/4 to 1 inch at the potential disposal sites located adjacent to Redwood Creek. The removal of ground water in the area has been almost completely stopped within the vicinity of the Ideal property; therefore, the rate of subsidence should progressively decrease to almost zero in a few years (1).

Settlement, or the downward movement of the ground surface, is caused by compression or consolidation of the underlying soils under the weight of fills and/or structures placed on the ground. The rate and total amount of settlement are dependent upon the depth of the dredged material placed, the thickness of the underlying mud, and the amount of consolidation the subsurface soils have already undergone (1).




SOURCE: Corps of Engineers (1975)(1).

ENVIRONMENTAL STATEMENT

SAN MATEO COUNTY CALIFORNIA

LOCATION OF
EXISTING PROJECT AND
ALTERNATIVE AQUATIC
DISPOSAL SITES

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN: FILE NO.
TRACED: TO ACCOMPANY REPORT
CHECKED: DATED APRIL 1978

PLATE 2


ENVIRONMENTAL STATEMENT

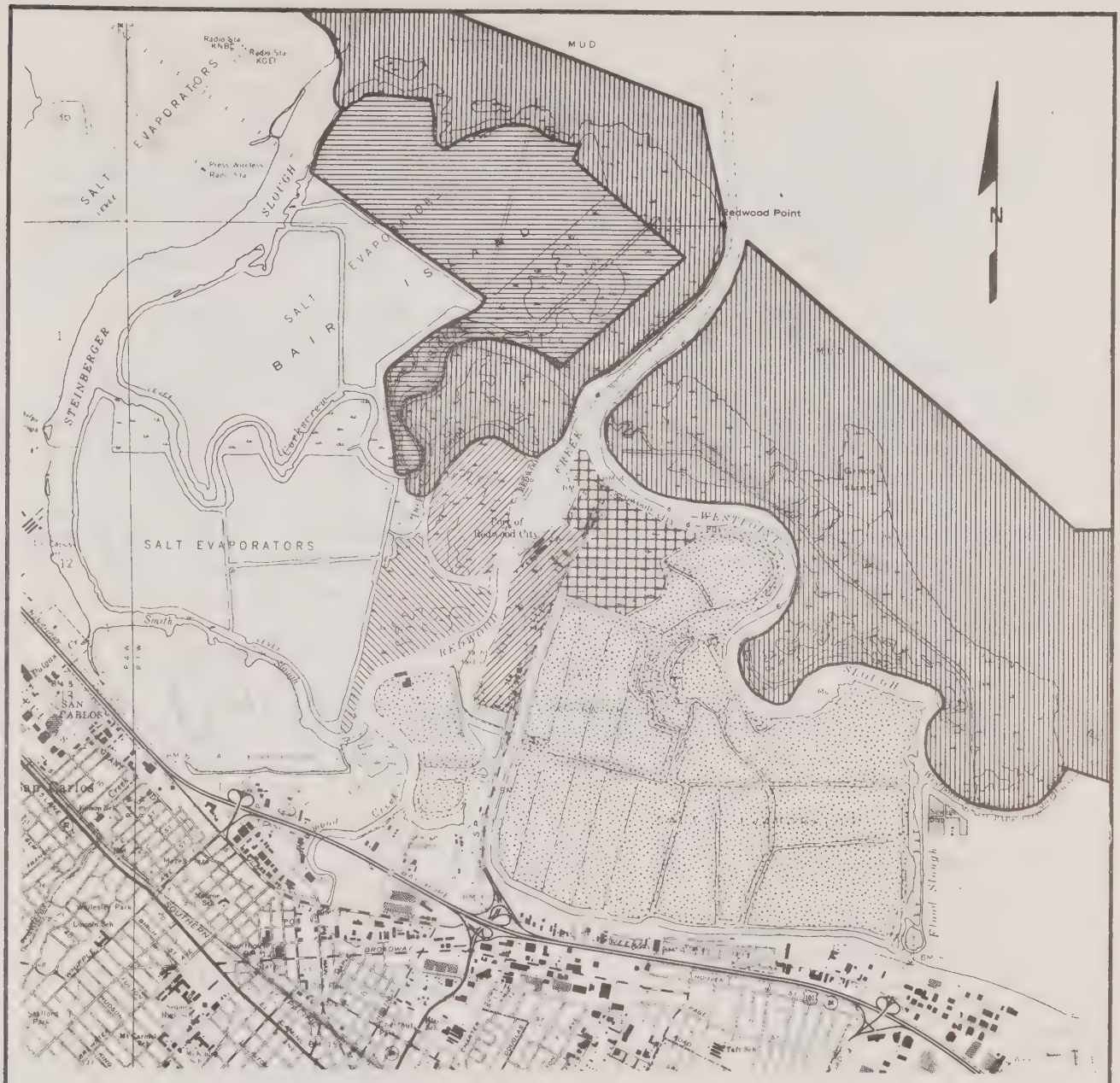
SAN MATEO COUNTY CALIFORNIA

LOCATION OF LAND
WITHIN STUDY AREA

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E FILE NO.

TO ACCOMPANY REPORT
DATED APRIL 1978

PLATE 3




LAND OWNERSHIP LEGEND:

- Port of Redwood City
- Ideal Basic Industries
- Cedra Properties
- Leslie Salt Company
- San Francisco Bay National Wildlife Refuge *
- State of California Wildlife Management Area

1000 0 2000 4000 6000 8000

SCALE IN FEET

* Some of these lands are leased.

SOURCE: H.K.S., Inc. (1977)(6).

ENVIRONMENTAL STATEMENT

SAN MATEO COUNTY CALIFORNIA

LAND OWNERSHIP
IN STUDY AREA

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
FILE NO.

TO ACCOMPANY REPORT
DATED APRIL 1978

PLATE 4

The Redwood City Harbor area lies in a highly active seismic region of the San Andreas fault, located 6 miles to the west, the Hayward fault, located 12 miles to the east, and the Calaveras fault, located 20 miles to the east. There is some inconclusive evidence that the old and inactive Palo Alto fault might be buried in bedrock near the south end of the harbor. The nature of the soils in the study area makes them susceptible to liquefaction during seismic activity (2).

Tsunamis, or waves generated by seismic activity, come from areas distant from San Francisco Bay. Tide gauge records show that tsunamis arriving at the entrance to San Francisco Bay are reduced as they extend around the Bay. The amplitude or height is reduced at least 75 percent by the time it reaches Redwood City. If one considers that a tsunami of 20 feet can occur every 100 years, then this would produce a wave height of approximately 5 feet at Redwood City. With mean higher high water at +7.8 feet (MLLW datum) and a +5 foot tsunami, the levees would be slightly overtopped. However, the greatest tsunami recorded at the Golden Gate was only 3 feet high, or a wave at Redwood City of approximately 9 inches (1).

3. Water Circulation.

The South Bay has considerable variations in the tidal range. The tidal elevations and ranges for Redwood Creek, based on mean lower low water (MLLW) datum are as follows:

TABLE 2

TIDAL DATA

| | (Feet, MLLW) |
|---|---|
| Mean Higher High Water | 7.9 |
| Mean High Water | 7.3 |
| Mean Tide Level | 4.25 |
| Mean Low Water | 1.2 |
| Mean Lower Low Water | 0.00 |

The duration of the long tidal ebb brings about the exposure of large areas of tidelands over long periods of time. The oxygen absorbed by the pores of the mudflat sediments exposed to the atmosphere during the ebb tide is partially released to the covering waters during the flood tide. This is important in the oxygenation process in the South Bay and Redwood City marshes where there is a marked tendency for stagnation. Tidal currents average 3-4 feet per second in the study area (2).

The Golden Gate area, from about one mile inside the bridge to four miles outside, is subject to violent swirls, eddies, whirlpools and boils. The eastern limit of the area is known locally as the "waterfall," and during ebb tides, steep rip tides and waves of 3.0 to 3.5 feet are not uncommon. The constricted passage of the Golden Gate which opens into the wide expanse of the Pacific Ocean and San Francisco Bay intensifies these violent conditions. During flooding, the tidal current at the Golden Gate parallels the channel with greater velocities along the north shore (Lime Point) than the south shore. Maximum flood velocity under the bridge is above four knots. The current sets easterly and follows the deep channels leading into north and south bays. Currents around Angel Island consist of swirls and are between one to two knots at maximum flood. They progress northward into San Pablo Bay at about the same rate (1).

Southeast of Angel Island, flood currents rotate counterclockwise and move past Treasure Island between one to two knots down the main channel. Maximum velocity under the Dumbarton Bridge is over two knots. Slack tide in the south Bay occurs three hours after maximum flood at the Golden Gate while in south central Bay, ebbing has begun. Maximum ebb under the Dumbarton Bridge is about two knots and generally increases above three knots at Treasure Island. Maximum ebb at the Golden Gate is close to six knots (1).

4. Sedimentation.

Tidal currents, freshwater inflow, salinity-density currents and wind affect sediment transport in the San Francisco Bay. Tidal currents are a dominating force in San Francisco Bay. They erode, resuspend, and transport sediments from Suisun and San Pablo Bays which enter, in suspension and as bedload, through Carquinez and San Pablo Straits into central San Francisco Bay. Once the sediment-laden waters arrive in the broad expanse of the central Bay, their velocity and ability to carry sediment becomes diminished. At the same time, these brackish waters are mixed with more saline ocean waters and suspended sediments settle to the bottom. These newly arrived sediments are subject to movement by additional estuarine processes. Non-tidal currents can have a localized effect on sedimentation and dredge/disposal operations (1).

One other factor affecting the annual sedimentation in the Bay system are annual dredging and disposal operations. Approximately 10.5 million cubic yards of Bay sediments are dredged annually by the Federal Government and private concerns in the Bay system. The majority of this material is disposed of in the Bay waters at either one of three disposal sites: the Alcatraz, San Pablo Bay or Carquinez Strait site (1).

5. Water Quality.

One of the main water quality parameters of concern in the South Bay is dissolved oxygen (3). Water samples taken during the Stanford Research Institute's study in 1974 for the Corps of Engineers at various stations in the Bay range between 7.1 to 8.0 milligrams per liter (mg/l) (11). Aquatic life requires a minimum of 5.0 mg/l dissolved oxygen or more, for sensitive stages of the life cycle of various organisms. Other water quality parameters are shown in Table 3.

The Regional Water Quality Control Board has designated the South Bay as water quality limited in their S.F. Bay Water Quality Control Plan(4). This means that they expect the present pollution problems to continue even with compliance to the 1977 effluent limitations established by the Federal Government. This plan ranks the south Bay as "Number One" in the allocation of financial resources for water quality control (4).

Sediment samples have been taken in Redwood Creek by the Port of Redwood City in February 1977. Sediment samples were also taken in Deepwater Slough, in connection with the Port's permit to construct a dike on Bair Island using material from Deepwater Slough. The sediment analysis for these samples is included as Appendix B. The sediment samples are considered "unpolluted" by the Environmental Protection Agency's interim "Dredge Spoil Disposal Criteria" (5). The Environmental Protection Agency is in the process of changing the criteria and testing requirements for aquatic disposal in "inland waters", including San Francisco Bay. These guidelines would be followed when they become available.

6. Air Quality.

The climatic and topographic conditions in the study area are such that a temperature inversion forms quite readily. During most of the summer months, and occasionally during the winter, the air from the North Pacific High (a semi-permanent high pressure cell located above the North Pacific) flows into the air basin forming a layer of denser and warmer air above the cooler and moister marine air located near the surface. This creates a very stable inversion layer, which prevents the vertical mixing of the air. As a result air is trapped below the inversion layer which prevents the dispersal of air contaminants.

The high pollution months for carbon monoxide (CO), oxides of nitrogen, and hydrocarbons are October to February while the highs for photochemical oxidants occur between June and October. The photochemical oxidants are produced by the action of sunlight combining hydrocarbons and nitrogen oxides. The other pollutants are highest when the dispersive power of the atmosphere is least. This occurs in winter when the mean wind speed is weakest and vertical mixing is least, due to the frequent occurrence of early morning temperature inversions near the surface. The peak CO concentration occurs in the winter half of the year at about 8 a.m. and between 6 and 10 p.m.; these times coincide with the peak traffic and the minimum capability of the atmosphere to disperse contaminants (3).

TABLE 3

WATER QUALITY DATA 1/

| Parameter | Station 2/ South Bay SB-A | SB-B | Redwood City RCH-A | RCH-B | Alcatraz | Hunter's Point |
|---|---|---|---|---|---|---|
| Mean Temp. (°C.) 3/73 - 6/74 | 14.6 | 14.6 | 14.9 | 15.1 | 12.1 | 13.4 |
| Mean Water Salinity (ppt) 6/74 | 21.0(I) 3/ | 21.3(I) | 21.5(I) | 21.5(I) | 29.5(HS) | 25.5(0) |
| Mean Water pH 6/74 | 7.85 | 7.85 | 7.85 | 7.9 | 7.8 | 7.9 |
| Mean Dissolved Oxygen (mg/1.) 6/74 - Collected Within 3 Ft. of Bottom | 7.5 | 7.4 | 7.1 | 7.2 | 7.8 | 8.0 |
| Total Sulfides in Water (micrograms/liter) 6/74 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mean Turbidity (nephelometric units) 6/74 | 12 | 10 | 40 | 22.5 | 11.5 | 35 |

1/ Source of Data: Corps of Engineers. 1975. (11)
2/ Stations Identified in Dredge Disposal Study. (11)
3/ Tidal Status: (I) = Incoming, (HS) = High Slack Tide, (0) - Outgoing.

The following table shows the number of days that State and Federal standards for air quality were exceeded at the Redwood City station in 1974, 1975 and 1976.

TABLE 4

AIR QUALITY DATA - REDWOOD CITY

| | Contaminants | | | | |
|---|---|---|---|---|---|
| Year | Oxidant* | Carbon Monoxide* | Nitrogen Dioxide* | Sulfur Dioxide** | Suspended Particles** |
| 1974 | 20 | 0 | 2 | 0 | 5.8 |
| 1975 | 14 | 2 | 0 | 0 | 1.7 |
| 1976 | 16 | 10 | 0 | 0 | 13.0 |

* Number of days ambient air quality standard was exceeded.
** Percent of observed days when State air quality standard was exceeded.

SOURCE: Bay Area Air Pollution Control District, 1976.

7. Noise.

The major noise-producing activities in the study area are located along the eastern side of Redwood Creek. The Leslie Salt Company's crane and other salt processing equipment, activities of the Port of Redwood City, and operation of equipment at Levin Metals and Cal Portland Cement contribute to the noise level in the study area. The noise levels produced from these activities range from 56-90 dBA (6). Air traffic using the San Francisco International and San Carlos Airports and vehicular traffic on the Bayshore Freeway produce additional noise (7).

About 20 percent of the traffic between the Bayshore Freeway and the Marina located west of Harbor Boulevard and 50 percent of the traffic between the Marina and the northern end of Harbor Boulevard consists of trucks. Thus, Harbor Boulevard is a "significant source of intermittent noise" (6). A passing truck in an off-highway situation creates a noise level of approximately 82 dBA (6).

The Southern Pacific Transportation Company states that about 8 one-way train trips are made per day between 1 p.m. and 10 p.m. The railroad use creates a 60 Ldn (day-night noise level descriptor) noise contour which extends 280 feet on either side of the railroad line.

C. BIOTIC ENVIRONMENT

1. Vegetation.

There are three main vegetation types in the study area: phytoplankton, salt marsh vegetation and upland plants.

a. Salt Marsh. Recently there has been widespread recognition of the value of wetlands as feeding and nesting areas for birds and other wildlife and as nursery areas for many important fish. The decaying marsh vegetation forms detritus, which is crucial to the food chain or web in the Bay. Marsh vegetation also has an important role in: protecting shorelines from erosion, producing oxygen, converting carbon monoxide, which is toxic, to its non-toxic, carbon dioxide form, and providing habitat for wildlife, including several rare and endangered species.

An extensive pickleweed marsh with some Frankenia and marsh rosemary is located on Bair Island, bounded by Deepwater Slough and Redwood Creek. This ± 70 acre marsh, located along Deepwater Slough, provides habitat and food for marsh song sparrows, marsh wrens, many shorebirds and other wildlife (6). The extent of marsh habitat can be seen in Plate 5. Patches of cordgrass can be found in Deepwater Slough.

Extensive marsh vegetation can be found on small, flat islands in Westpoint and First Sloughs and along the borders of these waterways (refer to Plate 3 and 5). The marsh vegetation on Greco Island and on portions of Bair Island represents prime marsh habitat.

The intertidal channel between the Leslie Salt Company's bittern pond and the Ideal Basic Industries' land supports a fairly large pickleweed marsh. A dense growth of pickleweed can also be found along the outer perimeter of dikes between the Leslie Salt ponds and tidal sloughs on the eastern side of Redwood Creek. An extensive area of cordgrass surrounds the Redwood City Yacht Harbor basin. Some pickleweed, salt grass and Jaumea can be found at higher elevations in that area (6). (Refer to Appendix E for a complete list of plants found in the study area.)

The Cedra Properties' land on Bair Island, located south of Deepwater Slough and bounded by Redwood Creek on the southeastern side, is partially enclosed by dikes and appears to receive some tidal action from Deepwater Slough. Much of the area is covered with pickleweed. Patches of salt grass and some Spergularia plants are located along Redwood Creek. A dense growth of pickleweed is located along Deepwater Slough and Redwood Creek, however this entire area has not been surveyed.

Marsh vegetation not subject to tidal action can be found in the drainage channel which parallels Harbor Boulevard, adjacent to the Leslie Salt Company's evaporator ponds.

ENVIRONMENTAL STATEMENT

SAN MATEO COUNTY CALIFORNIA

AERIAL PHOTO OF
STUDY AREA

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
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PLATE 5

b. Vegetation on Dikes and Filled Areas. Brass buttons along with some grasses, clover and other vegetation can be found along the tops of dikes in the study area. This same kind of vegetation exists along the interior side of some of the dikes. The dikes adjacent to Flood Slough are barren (6).

The area surrounding the Redwood City Yacht Harbor has been landscaped, using exotic species. A mixture of grassland and coyote brush has become established on the higher filled areas on Bair Island and in other parts of the study area. According to HKS, Inc., the northern confluence of Deepwater Slough with Redwood Creek has been filled and supports manna grass, a native plant of limited distribution. It is also found on Greco Island and is used by wildlife as forage material (6). The southern confluence of Deepwater Slough with Redwood Creek has also been filled, but not to a high elevation. It supports pickleweed. Deepwater Slough receives tidal action from Corkscrew Slough, which has a break in the levee adjacent to Deepwater Slough.

The filled area on the western portion of the Ideal Basic Industries' property, located east of Redwood Creek and south of Westpoint Slough, supports large trees and shrubs on the higher portions, and coyote brush, sagebrush, and grasses on the areas with moderate heights (6).

c. Phytoplankton and Algae. Phytoplankton suspended in the open water and other algal forms on the mudflats, such as benthic diatoms, sea lettuce, blue-green and multi-cellular red and green algae, contribute greatly to the primary productivity of the Bay. Like all plants, the tidal flat algae produce enormous quantities of oxygen, necessary for sustaining life. These plants also serve as an important food source for many animals. Delisle believes that 70 to 80 percent of all primary productivity in the Bay occurs in shallow areas less than 6 feet in depth (8).

2. Shellfish and Other Invertebrates.

a. Redwood City Area. A multitude of mollusks, crustaceans and other animals are sustained by the salt marsh and mudflats in the study area. The over 100 documented species of mud dwelling organisms off Bair and Greco Islands are faced with a variety of biological problems, including the reduced amounts of oxygen available. The mud clam (Chione spp.), Cirratulid worms and the ghost shrimp (Callianassa californiensis) abound in the mud flats and marsh areas.

Beds of soft shell clams and Japanese littleneck clams were located off of Bair Island by the California Department of Fish and Game in 1967. (Refer to Appendix C for the scientific names of shellfish.) Gaper clams were observed near the docks of the Port of Redwood City.

The "Redwood Creek Bed" was sampled by Fish and Game in 1967. Results indicate that an estimated 9,000 soft shell clams and 594,000 Japanese littleneck clams lived in this bed in 1967 (9). Live, native oysters were also present in this bed and are fairly common in the Redwood Creek area (9,10). The ribbed horsemussel is common in the Redwood Creek area among the roots of cordgrass (10). Other invertebrates, such as jelly fish, tunicates and fouling organisms are also well-represented there (10).

The dungeness crab has also been found in Redwood Creek, which it uses as a nursery area. This nursery area makes a significant contribution to the dungeness crab fishery (10).

Informal communication with staff of the California Department of Fish and Game has indicated that one could reasonably expect the mud or bentnose clam and the white sand clam to live in Deepwater Slough on Bair Island.

The Stanford Research Institute (SRI) conducted a study of the benthic community in the San Francisco Bay for the Corps of Engineers' Dredge Disposal Study (11). The three alternative, aquatic disposal sites considered in this working paper, the South Bay, Hunter's Point, and Alcatraz sites, were included in this benthic study. A summary of the findings follows. A more detailed discussion of the study results is included as Appendix D.

b. South Bay Aquatic Site. Two sampling stations were established at the South Bay aquatic disposal site. Station SB-A was located at the southern end of the site, and Station SB-B was located at the northern end, 3,000 feet away from SB-A. During this study, 5,000 cubic yards of dredged material from Redwood City Harbor was disposed of at the southern station SB-A. The northern station served as a "control", in order to determine which changes in the bottom population could be attributed to disposal. Sampling of the benthos occurred between March, 1973 and June, 1974 (11).

The Dredge Disposal Study indicates that this aquatic site supports a diverse benthic (bottom) population that includes polychaetes, arthropods, molluscs, bryozoans, copepods and cnidarians. Similar kinds and numbers of organisms were collected at both stations. However, the size of the benthic population fluctuated more at Station SB-B than at SB-A. In addition, different species or groups of organisms dominated the samples during different times of the year (11).

c. Hunter's Point Aquatic Site. Only one sampling station was used in the SRI study, during which no disposal took place. The variety of species collected here was even greater than at the South Bay Disposal Site, numbering 138 species or types. This represented the largest

number of species collected from any station in San Francisco Bay. Many of the invertebrate groups were represented at this site, and most of these types were derived from the continental shelf outside the Golden Gate and are strictly marine species (1).

d. Alcatraz Aquatic Site. This site is an established disposal site for dredged material that has been used for many years. One station was established at this site during the SRI study.

The Alcatraz disposal site was found to be unique: many of the animals collected were not found elsewhere in the Bay, and the composition and size of the population fluctuated markedly. Nearly all the 133 types collected at this site could be considered transient. Only the nematodes, oligochaetes, and the mollusc Adula diegensis were found in all surveys of this station. No species of mollusc were abundant. The greatest species diversity occurred in December, 1973, dominated by the polychaetes (11). Like the bottom fauna at the Hunter's Point site, most of the organisms collected can be considered typically marine, originating from outside the Golden Gate.

3. Fish.

The organisms and plants of the salt marshes and mudflats in the study area support a rich and varied community of fish species. The U.S. Fish and Wildlife Service conducted trawls and beach seines in 1975 and 1976 off of Bair Island, Greco Island and in Belmont Slough, Bay Slough, and Corkscrew Slough, all areas within and adjacent to this study area. A complete list of fish species found during this survey and by the California Department of Fish and Game is included as Appendix C. Topsmelt, shiner surfperch, northern anchovy and English sole were the most numerous species in all of the areas surveyed and appeared mainly between March and July. Most of these species were observed in Corkscrew Slough and would be expected to live in Deepwater Slough.

4. Wildlife.

This section has been detailed more than other sections in the Environmental Profile due to the importance of and the controversy surrounding terrestrial wildlife in the study area. Wildlife in the study area are discussed under the different habitat types. A list including wildlife species observed in the Redwood City Harbor area is included as Appendix E.

a. Tidal Flats. The tidal flats support a myriad of shorebirds. As the tide ebbs, the longer legged birds, such as avocets, black-necked stilts and marbled godwits, who use their long beaks to probe beneath the shallow waters, appear first on the mudflats. As the flats are exposed, these birds are joined by shorter legged birds,

including dunlins, sandpipers and snowy plowers (2). Fairly large numbers of shorebirds and sandpipers were observed feeding and resting on the Port's and Cedra Properties' land on Bair Island (refer to Plate 4 for land ownership). Invertebrates, such as clams and worms, living in the mudflats, provide food for many birds.

b. Salt Marsh. The marshes also support abundant bird life. The marshes in the study area are primarily composed of pickleweed, with some cordgrass in the lower elevations. In the cordgrass nest the many birds who are year-round residents, including Forster's terns, grebes, avocets and cinnamon teals. The salt marshes in the study area provide resting areas for the shorebirds during high tides (2). A gradual gradation from tidal flats to salt marsh and finally to upland habitat is important for much of the wildlife in the Bay ecosystem.

The bay and marsh lands serve as an important part of the Pacific Flyway. Many migratory birds winter in the Redwood City marshes. It is estimated that the South Bay furnishes food, shelter, and rest to seventy percent of the water and shore birds using the Pacific Flyway. These birds and their habitat are protected by the Migratory Bird Treaty Act of 1918 as amended in 1936 to include the Convention between the United States of America and Mexico. The provisions of this Treaty provide for the maintenance and protection of migratory fowl and, hence, makes the protection of habitat incumbent upon the signatory nations (2).

The sloughs which transect the marsh and the open water of the Bay furnish food for birds such as the pelican. Corkscrew Slough and Bair Island also support a colony of harbor seals, which also frequent Redwood Creek and Westpoint Slough (2,6).

c. Salt Ponds. The salt ponds, though man made, fulfill an important wildlife function. Originally vast marsh areas, the ponds were formed by diking and then pumping in Bay water for the manufacture of salt by solar evaporation. The California Department of Fish and Game noted during its survey in 1971 the importance of isolated levees surrounding the salt ponds for nesting birds (12). Forster's and caspian terns, avocets, black-necked stilts, snowy plovers, killdeer and limited numbers of waterfowl use the levees as nesting sites (12). The salt ponds are used extensively by birds as resting areas while waiting out the high tide (2,6).

The salt evaporator ponds, operated by the Leslie Salt Company, support a variety of red-pigmented bacteria and flagellates which provide food for the brine shrimp. About 50-100 pounds of brine shrimp are produced per acre per year in these ponds. The bittern storage ponds and crystallizers support only red-pigmented flagellates and bacteria (6). The brine shrimp provide a source of food for many birds, including scaup, redheads, and canvasbacks, willets, avocets, black-necked stilts and western sand pipers (2,6). On 24 February 1978, the California Department of Fish and Game observed fairly large numbers of black-necked stilts, avocets, scaup, dowitchers, godwits and Bonaparte's gulls

feeding in the shallower portion of the wash ponds, located near the "salt stack" (46). The exact nature of this food source in this particular area has not been identified.

The California Department of Fish and Game conducted a study of the relationship between saltponds and wildlife in the South Bay in 1970 (13). They found that eared grebes, diving ducks, phalaropes and the Bonaparte gull preferred the more saline salt ponds, which had a higher food value. In constrast, 3 species of herons, dabbling ducks and coots showed a preference for ponds with a low salinity. These birds use the saltponds seasonally, primarily between July and March (13).

The shorebirds (except phalaropes) showed no preference for salinity, however they require shallow water for feeding, and thus seemed to prefer the more saline or shallower ponds. These shorebirds use the salt ponds year-round, however, their peak use occurs from mid-April through November. Terns did not show any preference for salinity (13).

d. Dikes and Filled Areas. Marsh hawks have been observed flying over diked and filled areas in the study area, which support a large population of rabbits and some rodents upon which raptors feed (6). Several jackrabbits were scared out of the pickleweed marsh on the Port's land on Bair Island during field work. There was evidence of rabbits or other small mammals on much of this land. Animal tracks of a large, hoofed animal were noted on the Cedra Properties' land on Bair Island. Many animals frequent the upland areas and the higher land created by filling along Redwood Creek just out of reach of the high tides which inundate sections of the marsh. Coyote brush and gum plants provide cover and food for the red-winged blackbirds, song sparrows, wrens and other birds. The grasslands on portions of Bair Island are diverse in numbers of plant species, but support little dependent wildlife (12).

e. Nesting Birds on Bair Island. Bair Island is extremely important in providing isolated nesting habitat for many birds. A bird breeding survey of the South Bay, conducted by the California Department of Fish and Game in 1971, identified nests of the following birds only on Bair Island: the great blue heron, black-crowned night heron, snowy egret, common egret, white-tailed kite, killdeer, loggerhead shrike, and western meadowlark (12). Colonies or nests of the following species were observed on Bair Island as well as in other parts of the South Bay: mallard, pintail, marsh hawk, American avocet, black-necked stilt, caspian tern, house finch, red-winged blackbird, and coastal savannah sparrow (12).

Many of these birds nest either on the coyote brush or gum plants on the higher portion of the Bair Island, on the levees surrounding the abandoned salt ponds, or in the marsh (12). Plate 6 shows the predominant nesting and resting areas on Bair Island based on an Environmental Study prepared under an agreement between Mobile Oil Estates, LTD and the State Lands Commission (14).

5. Rare and Endangered Species.

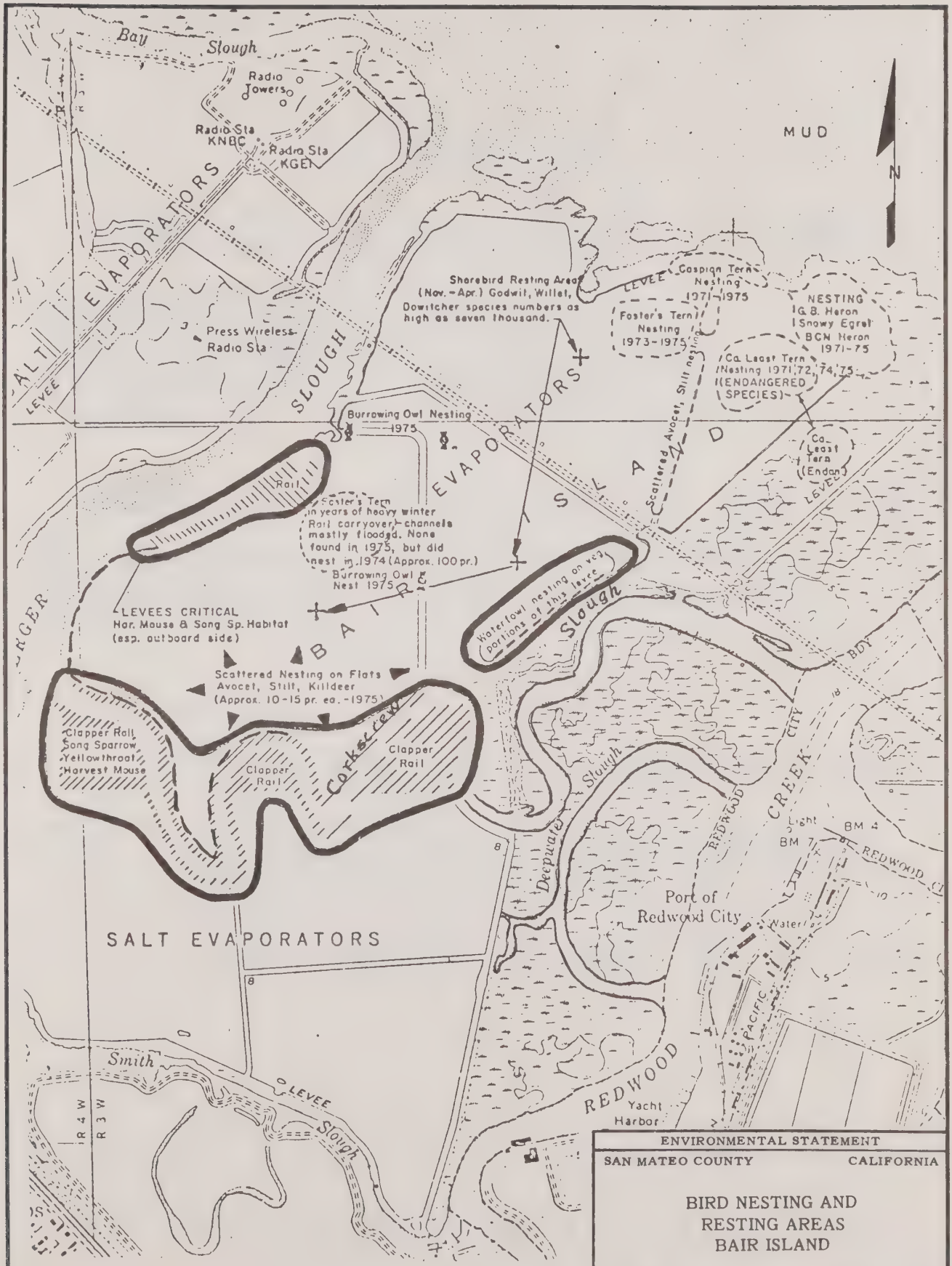
Five rare or endangered wildlife species inhabit the vicinity of Redwood City Harbor: the California brown pelican, the California clapper rail, the California black rail, the California least tern, and the salt marsh harvest mouse. The status of each of these species as well as their scientific names is included in Table 5.

a. California Brown Pelican. Brown pelicans have been observed on a spit of land created by cement waste on Redwood Creek north of the Port of Redwood City and probably frequent other portions of the study area (2).

b. California Clapper Rail. The salt marshes on Greco Island and near Redwood City, in the study area, represent some of the most extensive, undisturbed marsh habitat in the South Bay (12). Both primary and secondary habitat for California clapper rails has been identified on Bair and Greco Islands by the California Department of Fish and Game in 1971. Primary habitat is pure stands of cordgrass; secondary habitat includes pickleweed, possibly mixed with cordgrass or other marsh vegetation (12). The survey located primary habitat and breeding evidences along Corkscrew Slough and Bair Island's outer bay margin, and secondary habitat on lands between Deepwater Slough and Corkscrew Slough (2). Major populations of the endangered clapper rail in the South Bay are located in San Mateo, Santa Clara and Alameda Counties. The clapper rail actively nests between mid-April and mid-July, with a peak occurring in May (12).

A preliminary draft report on the distribution and abundance of the California clapper rail has been prepared by Fish and Game (15). Surveys performed between 1971 and 1975 indicated sitings of fairly large numbers of clapper rails in pickleweed or pickleweed mixed with cordgrass vegetation in the following areas in and adjacent to the study area: Corkscrew Slough, Greco Island, Deepwater Slough/Corkscrew Slough, Bair Island, Ravenswood Slough, and Westpoint Slough. The report goes on to mention that the marsh habitat bordering Redwood Creek, Westpoint, Smith, Steinberger and Belmont Sloughs, and Bair and Greco Islands supports resident and breeding populations of clapper rails (15).

c. California Black Rail. The rare California black rail has been observed nesting in the salt marshes in the South Bay, prior to 1972 (2). It has also been observed on portions of Bair Island (17). The California Department of Fish and Game conducted a breeding season survey in San Francisco Bay in 1977. Black rails were not observed or heard in the South Bay (16). No black rails were counted in Corkscrew Slough or on Greco Island in 1977. Manolis attributed this to the lack of high marsh habitat in the South Bay. The withdrawal of ground water has caused subsidence of the salt marshes in the South Bay (16). Many




SOURCE: State Lands Commission (1977).

ENVIRONMENTAL STATEMENT

SAN MATEO COUNTY CALIFORNIA

# BIRD NESTING AND RESTING AREAS BAIR ISLAND

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E

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PLATE 6

TABLE 5

RARE AND ENDANGERED SPECIES

| ANIMALS<br>Scientific Name | Common Name | Status:<br>Federal/1 | <br>State/2 |
|---|---|---|---|
| *Rallus longirostris obsoletus* | California clapper rail | E | E |
| *Sterna albifrons browni* | California least tern | E | E |
| *Latterallus jamaicensis* | California black rail | - | R |
| *Reithrodontomys raviventris* | Saltmarsh harvest mouse | E | E |
| *Pelecanus occidentalis californicus* | California brown pelican | E | E |

| PLANTS<br>Scientific Name | Common Name | Family | Unofficial<br>Status/3 |
|---|---|---|---|
| *Cordylanthus maritimus ssp. palustris* | Point Reyes bird's beak | Scrophulariaceae | E* |
| *Perideridia gairdneri ssp. gairdneri* | Gairdner's yampah | Umbelliferae | E* |

LEGEND: E = Endangered
R = Rare
E* = Very limited in distribution, endangered in part, analagous to E (see text).

SOURCE: 1/ U.S. Fish and Wildlife Service, "Endangered and Threatened Wildlife and Plants." Federal Register, 14 July 1977 (27).
2/ California Department of Fish and Game. 1976. At the Crossroads.
3/ California Native Plant Society. 1974. Inventory of Rare and Endangered Vascular Plants of California. Spec. Pub. #1 (23)

of the salt marshes in the South Bay are inundated completely by peak high tides. This species appears to prefer a gradual change from marsh to upland habitat, not an abrupt change, such as occurs in a levee adjacent to a marsh. This species also prefers heavy growths of pickleweed (16). Thus, it seems possible that the California black rail may be frequenting some of the pickleweed marsh on the Port's land on Bair Island, which grades rather gently into upland habitat, located on top of the mounds of past dredged material. The California Department of Fish and Game plans to survey the study area for this rail, as well as the California clapper rail and salt marsh harvest mouse in the near future (18).

d. California Least Tern. One to fifteen pairs of the endangered least tern have been observed nesting on the dried "mudflats on Bair Island during 1969, 1970, and 1974 through 1977 (12,19). A few pairs of least terns nested on a dry salt pond, located to the west of Westpoint Slough, in 1976. These nests were on the edge of a Forster's tern colony (19).

The California Department of Fish and Game has prepared a Draft Recovery Plan for this species which identifies proposed "essential" habitat for the California least tern on Bair Island. This "essential" habitat, shown on Plate 7, has been proposed as "critical" habitat by the California Department of Fish and Game and is protected as such until official designation by the U.S. Fish and Wildlife Service (20). The California least terns have experienced heavy predation by Norway rats and short-eared owls (12).

e. Salt Marsh Harvest Mouse. A survey for the endangered salt marsh harvest mouse in S.F. Bay by the California Department of Fish and Game in 1971 revealed that Bair Island has one of the largest populations in the South Bay (21). Salt marsh harvest mice were trapped at the confluence of Corkscrew Slough and Redwood Creek on Bair Island in 1971. Trapping indicated the presence of this species on Greco Island, but high tides which inundate the pickleweed and cordgrass, limit this population (21). Personnel of the California Department of Fish and Game surveyed the Cedra Properties' land on Bair Island and the marshlands adjacent to Corkscrew and Deepwater Sloughs during February, 1978. One salt marsh harvest mouse was trapped on the Cedra Properties site on 22 February 1978 (22). The removal of pickleweed marsh habitat through diking and filling in the South Bay, as well as the problems arising from high tides which inundate much of the pickleweed, have reduced the population of endangered mice in the South Bay to an "extremely low level" (21).

Informal communication with staff of California Department of Fish and Game has indicated that the salt marsh harvest mouse would be expected to occur in higher portions of the pickleweed zone in the study area, such as the Port's property on Bair Island and on the marsh located on the Ideal property. Fish and Game personnel plan to conduct additional surveys in this area in the near future (17,18,22).


SOURCE: California Fish and Game (1977).

| ENVIRONMENTAL STATEMENT | |
|---|---|
| SAN MATEO COUNTY | CALIFORNIA |

PROPOSED ESSENTIAL HABITAT
CALIFORNIA LEAST TERN

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
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PLATE 7

The following species are not considered rare or endangered, however there distribution is limited and they have been observed in the study area: the white-tailed kite, golden eagle, salt marsh song sparrow and vagrant shrew (2).

f. Plants. The California Native Plant Society's list of rare and endangered plants indicates that the Point Reyes bird's beak is endangered and occurs in the Redwood Point area (23). According to Munz and Mason, this species grows in coastal salt marshes (24,25). This subspecies is not listed in either the candidate federal list of endangered species, prepared by the Smithsonian Institution or in the proposed federal list, published in the Federal Register on 16 June 1976 (26,27). However, the California Native Plant Society feels that this subspecies should have been included as endangered in the latter list. Please refer to Table 5 for the species and family names, and other information.

One other plant species listed by the California Native Plant Society is found in San Mateo County and may occur within the study area. Perideridia gairdneri ssp. gairdneri has been given the same status as the Point Reyes bird's beak and according to Munz, is found in wet places below 11,000 feet (24). This species is not on the candidate or proposed federal lists, mentioned above, but is shown in Table 5 and may occur in the study area.

## D. SOCIO-ECONOMIC ENVIRONMENT

### 1. Employment.

According to HKS, Incorporated, who prepared an environmental impact report on "Alternative Development Concepts for 2,135 Acres in and Aadjacent to Redwood City" for the City of Redwood City, there are presently 225 people employed in the study area. This represents 0.7% of the total employment in Redwood City. Employment is located at the Port of Redwood City's offices, the Lockheed facility, the Leslie Salt Company's operations, and other industrial operations (6). According to the same source, unemployment averaged 8.5 percent in Redwood City in 1976.

### 2. Commerce/Navigation.

Redwood City Harbor is the only deepwater harbor on the Bay south of San Francisco. It is almost entirely a bulk commodity port, with petroleum, scrap metal, cement and salt being the principal commodities handled. The Redwood City Harbor channel is a Corps of Engineers' project which was initially authorized in 1884 and was completed, in the "final" version, in 1965. In 1969, approximately 2,685,000 tons of cargo were shipped via Redwood City Harbor. By 1975, the figure had dropped to 575,000 tons. (Please refer to Appendix A for a more thorough discussion of the Port of Redwood City.)

The Leslie Salt Company presently operates the "Redwood City Plant" at a little less than 50 percent of full capacity. In 1974, the company decided to start phasing out the Redwood City salt production operation due primarily to heavy competition in the international market for salt and in part to development of sources in Australia. However, the Australian sources are not producing as expected and production is likely to be resumed. The salt produced in the study area is exported. The domestic market for salt is growing, and the Leslie Salt Company plans to move the Redwood City operation to their newer "domestic" plant in the East Bay. Thus, in several years, the Leslie salt evaporators in the study area may become surplus lands depending upon economic conditions here and abroad (refer to Appendix A).

3. Cultural Resources.

A comprehensive literature search was performed for the study area which included, but was not limted to, examination of maps and site data on file at San Francisco State University; California Archaeological Survey, Department of Parks and Recreation; San Francisco District, State Department of Transportation and the San Mateo County Historical Association. Research failed to identify the presence of significant cultural resources, either historic or prehistoric, within or contiguous to the study area. On 22 July 1976, two of the previously proposed disposal sites, located in the Leslie Salt Company's ponds within the study area, were subject to surface reconnaissance by Mr. Ed Kandler, Archaeologist for the San Francisco District, Corps of Engineers, in accordance with the Society for California Archaeology's recommended procedures for archaeological impact evaluation.

The salt evaporator ponds within the study area constitute cultural resources representative of a 19th century mod of commercial exploitation of the natural environment practiced at numerous locations around San Francisco Bay. The evaporator ponds belong to the Leslie Salt Company and are in current operation. While they must be considered as industrial cultural resources, they are not considered to be "significant", in terms of the criteria for eligibility to the National Register of Historic Places. The frequency and distribution of alternate operational salt evaporator ponds, many in association with more complex harvesting and refining operations within the local area and throughout the San Francisco Bay area, support the finding that these ponds are not uniquely representive of the period or mode of economic activity.

No historic resources other than the salt evaporator ponds, or prehistoric resources, were identified within or immediately adjacent to the study area. If other disposal sites in the study area appear feasible following circulation of this working paper, a cultural resource reconnaissance of the sites would be performed.

4. Existing Land Use.

Four major types of land use categories are represented in the study area: lands used for salt production, port facilities, marinas, and marshlands. The Leslie Salt Company is presently using a portion of the salt evaporation, crystallizer and bittern storage ponds located on the eastern side of Redwood Creek in the salt production process. The ponds located next to the "salt stack" are used to wash the salt (refer to Plate 3 for location of salt stack and Plate 4 for land ownership).

The Port of Redwood City has offices comprising about 3,500 square feet on the eastern side of Redwood Creek. The Port leases some of its lands to four to five companies which are involved in scrap metal storage and transport, transportation of lumber and cement, and fuel transport and storage. The waterfront along the eastern shore of Redwood Creek includes four to five large wharves used by the tenents of the Port. (refer to Appendix A for a more thorough description of Port facilities).

The Redwood City Municipal Marina, recently turned over to the Port of Redwood City for operation, provides berths for recreational boats on the eastern side of Redwood Creek, located to the south of the Port facilities. The marshlands located on the Ideal, Cedra and Port properties (see Plate 4) receive some degree of tidal inundation and support wildlife and aquatic organisms in the Bay. These marshlands are not inhabited by humans. The Federal and State fish and wildlife agencies either own or are in the process of acquiring the marshlands and abandoned salt ponds on outer Bair and Greco Islands, located in and adjacent to the study area (refer to Plate 4).

For a discussion of land use plans, please refer to Section 4, paragraph D.

5. Farmland/Soils.

The lands owned by the Leslie Salt Company are under the "Williamson Act" or the California Land Conservation Act of 1965, since the lands are used for the production of salt (6). The soils in the salt ponds are more saline than the soils in the Bay or nearby marsh areas, and do not provide suitable conditions for most vegetation prior to leaching or other treatment.

6. Community Growth.

Various land use and development plans have been prepared for the City and Port of Redwood City which include the study area. In addition to these plans, the City of Redwood City and the Bay Conservation and Development Commission (BCDC) are jointly preparing a "Special Area Plan" for the study area which will become the guiding document for land use and thus for "growth" in the study area.

Ultimate land use in the study area will most likely include both (1) Port and industrial growth and (2) marsh preservation and creation for fish and wildlife purposes and recreation.

7. Private Property/Property Values.

Private land in the study area is owned by three companies: Leslie Salt Company, Ideal Basic Industries and Cedra Properties, Inc.. The City of Redwood City has a fairly small parcel adjacent to their yacht harbor. The Port of Redwood City owns land on both sides of Redwood Creek. Land ownership in the study area is shown on Plate 4.

The following information is extracted from the Final Environmental Impact Report (EIR) on Alternative Development Concepts for 2,135 Acres in and Adjacent to the City of Redwood City, prepared by HKS, Incorporated in July, 1977 (6). The land in the study area was assessed at $980,200. Improvements in the study area were assessed at $483,670. Thus, the total assessed value of the study area was assessed at $1,463,870. According to HKS, Inc., "almost all of the lands owned by the Leslie Salt Company are under the provisions of the California Land Conservation Act of 1965 known as the Williamson Act" (6). Thus, these lands are assessed according to their use value in salt production, rather than their market value (6).

8. Tax Revenue/Local Government Finance.

Based on 1976-1977 tax rates, the Leslie Salt Company, Ideal Basic Industries and Cedra Properties, Inc. pay a total of $130,970 in property taxes annually. About half of these taxes are paid to the City of Redwood City and half to San Mateo County. Texaco, Inc. and Levin Metals, private tenants with long-term leases, are considered possessory interest holders and pay a total of $128,880 in taxes, annually, based on 1976-1977 rates (6).

9. Recreational Opportunities.

Redwood City Harbor, located south of the Port's land on the eastern side of Redwood Creek and adjacent sloughs provide shelter for recreational vessels. The majority of the upper harbor traffic consists of shallow draft recreational vessels in transit between the Bay and anchorage and service areas (2). Redwood Creek recreational boating depends on maintenance dredging and is an important land and water use for Redwood City (3).

Areas of the marsh adjacent to Redwood Creek are used for hiking, birdwatching, hunting, and occasionally fishing and picnicking. Access to marsh areas on Bair and Greco Islands is limited to boaters. Interior access to the marshlands on Bair Island, once Redwood Creek is crossed, is provided by the maintenance walkway which parallels the large power transmission lines which cross the area (2).

The northeasterly portion of Bair Island, comprising 800 acres, has been turned over from Mobile Oil Estates, L.T.D., to the California Department of Fish and Game to be managed as a state wildlife management

area. Mobile Oil Estates has agreed to set aside an additional 60 acres on Bair Island for open space. The San Francisco Bay National Wildlife Refuge includes the northeastern perimeter of Bair Island, adjacent to the Bay, the land north of Deepwater Slough and south of Corkscrew Slough, and Greco Island, located adjacent to the study area. Thus, most of the land located bayward of Corkscrew Slough on Bair Island and Greco Island are dedicated to wildlife use, with some environmental education and recreation-type activities included in proposed future plans (3,29).

10. Aesthetic/Visual Values. The study area can be characterized by the extensive salt ponds (both active and inactive) and marshland, and the commercial/industrial activities on the eastern shore of Redwood Creek. The large Leslie Salt Company's salt stack, shown on Plate 4 and located in the middle of the study area, southeast of Bair Island and southwest of the Port facilities, is a prominent visual feature. The environmental impact report prepared by HKS, Inc. designates this area as the tranzition zone between the city/residential area on the uplands south of Bayshore Freeway and the Bay (6).

## E. ENVIRONMENTAL RELATIONSHIP MATRIX

The environmental relationship matrix that follows was developed to identify the existing environmental relationships in the study area. These relationships provide information to be used in assessing the ecosystem's response to natural and manmade changes either directly or indirectly associated with the alternatives.

In analyzing this matrix, it must be remembered that a change in one of the active elements results in a change in a passive element. Degrees of this relationship are indicated by letters, identified in the legend. Based on this relationship matrix, secondary and higher order impacts can be identified from primary impacts.

# ENVIRONMENTAL RELATIONSHIP MATRIX

| PASSIVE ELEMENTS / ACTIVE ELEMENTS | Topography | Geologic Hazards | Water Circulation | Sedimentation | Water Quality | Air Quality | Noise | Vegetation | Shellfish & Other Invert | Fish | Wildlife | Rare & Endangered Species | Employment | Commerce/Navigation | Cultural Resources | Existing Land Use | Farmland/Soils | Community Growth | Private Prop./Prop. Values | Tax Rev./Local Gov't Finance | Recreational Opportunities | Aesthetic/Visual Values |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Topography | | M | T | T | | | | T | | | | | | M | | C | S | | | | T | |
| Geologic Hazards | S | | T | S | | | | T | | | | | | | | | | | | | | |
| Water Circulation | C | S | | C | T | | | M | | | | | | | | | | | | | | |
| Sedimentation | T | S | C | | T | | | | | | | | | | | T | | | | | | |
| Water Quality | | | C | | | | | M | T | | | | | M | | T | C | M | | | S | |
| Air Quality | T | | | | | | | S | | | | | T | S | | C | T | C | | | T | |
| Noise | T | | | | | | | T | | | | | | S | | M | | M | | | T | |
| Vegetation | C | M | M | S | M | T | | | | | S | | | | | C | | S | | | S | |
| Shellfish & Other Invert. | C | | C | M | C | | | C | | T | S | S | | | | C | | | | | T | |
| Fish | | | M | S | C | | | C | M | | S | S | | | | | | | | | T | |
| Wildlife | C | T | | | M | S | S | C | M | M | | T | | | | C | T | M | | | M | |
| Rare & Endangered Species | C | T | C | T | M | S | S | C | C | M | T | | | | | C | T | M | | | S | |
| Employment | | T | | T | | T | | | S | S | T | | | C | | C | T | M | | S | S | |
| Commerce/Navigation | | | | C | | | | | S | S | | | | | S | C | T | T | | S | | |
| Cultural Resources | M | | C | T | | | | | | | | | T | | | C | T | T | | | C | |
| Existing Land Use | C | C | | T | | M | S | C | | | T | | | C | M | | T | | T | | | |
| Farmland/Soils | T | T | | T | T | T | | T | | | T | | T | T | | T | | T | T | | T | |
| Community Growth | M | | | | T | | | | | | | | M | | | C | | | M | | T | |
| Private Prop./Prop. Values | C | T | T | T | | | T | T | | | | | | | | M | T | | | T | S | T |
| Tax Rev./Local Gov't Finance | | | | S | | | | | | | | | S | M | | C | M | C | M | | M | |
| Recreational Opportunities | M | | S | M | S | M | S | M | M | M | M | S | T | S | | C | | M | S | T | | M |
| Aesthetic/Visual Values | M | | T | T | S | M | S | C | | | S | S | | S | | C | T | M | | | | |

LEGEND:

Primary Relationships:
- C = Critical
- M = Moderate
- S = Slight
- T = Theoretical, but not identified in study area.

## SECTION 3

## ALTERNATIVES AND IMPACTS

### A. INTRODUCTION

This working paper emphasizes developing an array of alternatives for disposal of dredged material which would be generated by maintaining the Redwood City Harbor Project. This report evaluates the alternative of no action, land disposal, aquatic disposal and marsh creation alternatives.

### B. THE NO ACTION ALTERNATIVE

#### 1. Description of the Alternative.

In an area similar to the study area, the environmental conditions would be expected to change with time in response to changing physical, biological, and socio-economic characteristics. Changes in the environment take place in response to natural on-going processes and to man's activities. Such changes will take place regardless of whether any plans are implemented. The no action alternative implies that disposal of dredged material generated by maintenance of the Redwood City Harbor project would not occur. The projection of future conditions, as described in the environmental profile, is that which would result from the no action alternative.

#### 2. Impacts of the Alternative.

The most significant effect of the "no action" alternative would be the discontinuation of maintenance dredging in the Redwood City Harbor navigation channels. This would have a great impact on the Port of Redwood City. The navigability of the Redwood Creek channel would slowly decrease and eventually the Port would have to remove or relocate their facilities. Land use in the study area would probably change in the future, with the no action alternative. Future land use and development of lands in the study area depends on the formulation of a "Waterfront Special Area Plan" for Redwood City. This plan is presently being developed by a "Special Area Plan Committee," representing many agencies and interests, which meets monthly. The Plan is scheduled to be completed towards the end of 1978. The Leslie Salt Company's lands may eventually become surplus property, with a first priority for purchase by a public entity. It can be assumed that some portion of the salt evaporation ponds in the study area and a portion of the lands on Bair Island would remain as open space.

## C. AQUATIC DISPOSAL ALTERNATIVES

Three aquatic disposal sites: South Bay, Hunter's Point and Alcatraz, have been considered as alternatives for aquatic disposal in this working paper. Each of these alternatives is described separately, however, the impact section has been combined due to the similarity of the alternatives' impacts on the environment. Unless otherwise stated, the impacts apply to all of the alternative aquatic disposal sites. Dredging and disposal could be accomplished using a hopper dredge or a clamshell dredge and barges. An impact tree, tracing the cause and effect relationship for these 3 alternatives, is shown on the following page. The significant impacts are discussed below. This tree is based on the environmental matrix in Section 2.

### 1. South Bay Disposal Site.

This alternative is to place dredged material from the Redwood City Harbor at the South Bay aquatic disposal site. This site is located immediately south of the San Mateo-Hayward Bridge (refer to Plate 2). The site occupies an area 1,500 by 3,000 feet in size, at a depth of 30 feet.

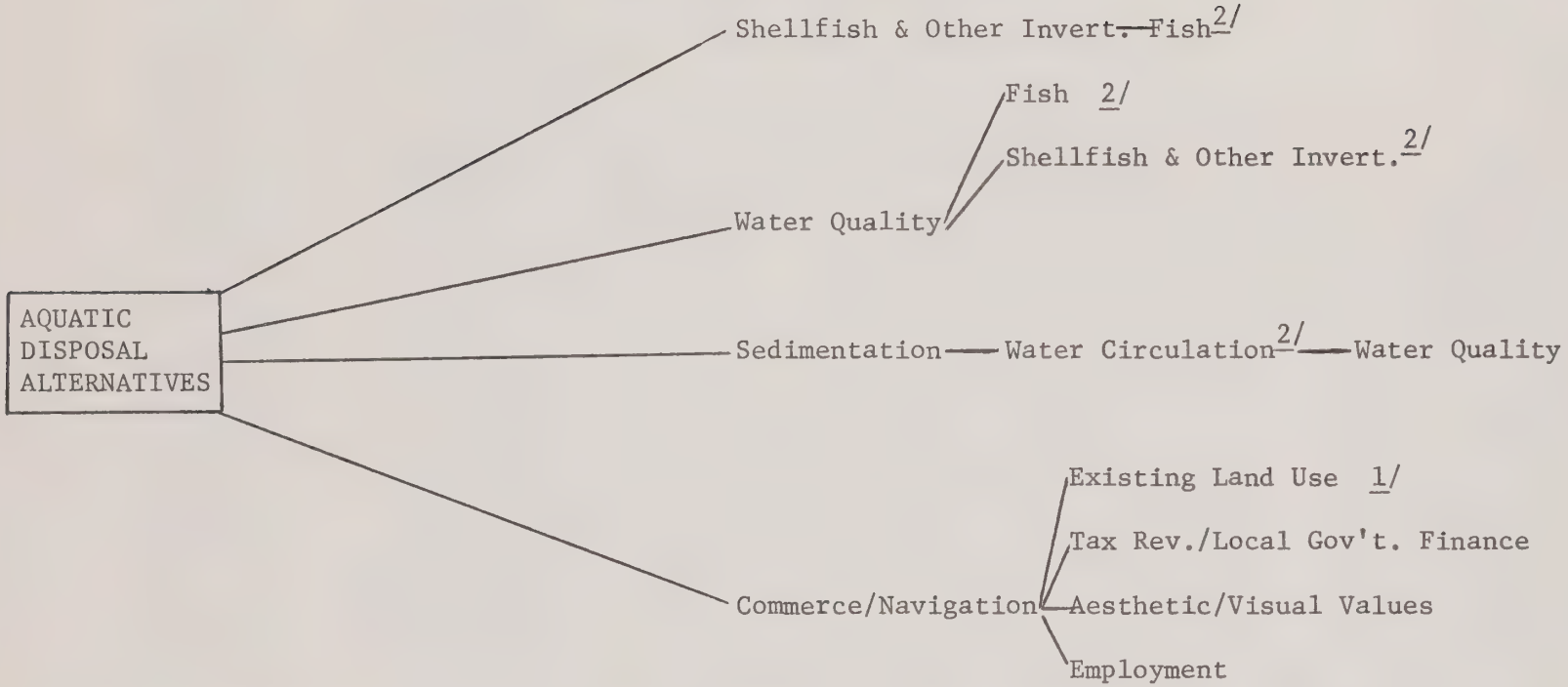
The South Bay disposal site was used for several years in the early 1970's in an attempt to centralize disposal activities in the South Bay. Before 1972, disposal of dredged material in the South Bay was indiscriminate, taking place just about anywhere, at the convenience of the dredger. The South Bay disposal site was used by the Port of Redwood City and several marinas in the South Bay, before its use was terminated because of ineffective use and the desire to reduce and consolidate aquatic disposal in San Francisco Bay. This site is not designated as a disposal site at present and hence is not utilized. Before utilization of this site could be considered, its joint designation by the Environmental Protection Agency (EPA) and the Corps of Engineers would be required.

### 2. Hunter's Point Disposal Site.

The Hunter's Point disposal site is located just offshore of Hunter's Point, San Francisco in about 50 feet of water (refer to Plate 2). The 2,000-foot diameter, circular site was established in 1972 to regulate aquatic disposal of dredged material from harbors in the general vicinity, however, it was seldom used. For this reason, among others, this site is no longer a designated site. Consideration of this alternative would require joint designation by EPA and the Corps, identical to that required for the South Bay disposal site.

FIGURE 1: IMPACT TREE

AQUATIC DISPOSAL ALTERNATIVES




The lines in this illustration are to be read as: _____ has a significant effect on . . . .

1/ A change in this factor would result in significant impacts on the entire system.
2/ The significance of this impact differs for some of the alternatives; refer to appropriate paragraph in Section 3.

3. Alcatraz Disposal Site.

The Alcatraz disposal site is an established site which is periodically used. This circular site, with a 2,000-foot diameter, is located 1/3 mile south of Alcatraz Island in about 130 feet of water (refer to Plate 2). Approximately 2.1 million cubic yards of Corps dredged material are placed here every year, plus another 1.2 million cubic yards by other interests (1).

4. Effects on the Physical Environment.

a. Sedimentation.

(1) South Bay Site. Most of the dredged material disposed of at this site is expected to remain in the South Bay. Tidal currents would probably distribute the sediment in the surrounding area, in a north-south direction. Current studies conducted for the East Bay Discharger's Authority on the Corps' hydraulic model of the San Francisco Bay and Delta indicate strong tidal currents in the deeper portions of the South Bay, but with poor tidal exchange (32). An increase in sedimentation in the South Bay could result in decreased tidal circulation.

(2) Hunter's Point Site. Field or model studies have not been conducted on the characteristics of sediment disposed of at the Hunter's Point aquatic site. The site is located in fairly deep water where there is a moderate amount of turbulence. One would expect some of the dredged material to be distributed to other portions of the Bay and possibly to outside the Golden Gate.

(3) Alcatraz Site. No field or model studies have been conducted on dispersion and long-term movement of dredged material disposed of at this site. Dredged material disposal tests were run in the Corps' S.F. Bay-Delta Hydraulic Model using gilsonite to simulate the dredged material, using the mean tide on 21-22 September 1956 and a Delta freshwater inflow of 16,000 cubic feet per second. Disposal occurred over 5 tidal cycles and was followed for an additional 15 tidal cycles, or about 15 prototype days. The model studies can only be used to predict the short-term distribution of dredged material, since it cannot simulate waves or currents caused by wind (1). The model studies showed the following distribution:

| Percentage (%) | Location |
|---|---|
| 1 | Extreme southern end of South Bay |
| 21 | South Bay between S.F. Airport and S.F. to Oakland Bay Bridge |
| 27 | Central Bay between Point San Pablo and S.F. to Oakland Bay Bridge |
| 3 | San Pablo Bay |
| 1 | Carquinez Strait |
| 47 | Outside the Bay system via Golden Gate |

Other model tests indicated that about 10 percent of the dredged material returned to navigation channels that are dredged.

The long-term distribution of dredged material is affected by wind-wave resuspension, which probably results in a greater portion of the material moving into dredged channels and outside the Golden Gate than was indicated in the model studies (1).

b. Water Quality. During aquatic disposal, trace metals and nutrients in the sediment are brought into direct contact with the water column for some period of time. This can result in the release of these elements into the water column. Due to the turbulent nature of the Alcatraz disposal site, some trace metals and nutrients in the dredged material would be released to some extent into the water column for this alternative. The metal releases are very low, usually measured in subparts per billion (1).

Observations in the field and laboratory indicate that addition to the water column of organic-sulfide rich dredged material, typical of that found in many parts of the Bay, immediately decreases the dissolved oxygen level for up to several minutes. The reduced dissolved oxygen level would be quickly restored at the Alcatraz site, due to its turbulent nature. Aquatic disposal at each of the alternative aquatic sites would cause a temporary increase in turbidity in the water column (1).

Several requirements exist for testing and analyzing sediment quality and its potential effects on water quality. Under present Environmental Protection Agency regulations, aquatic disposal would require bulk sediment analysis and an elutriate test. In some cases, a bioassay may be required (30). The U.S. Environmental Protection Agency

and the Corps of Engineers are currently formulating criteria for "inland water disposal" of dredged material. These criteria would be applied to the aquatic disposal sites considered, when the criteria are finalized.

Designation of a disposal site would require a thorough analysis of biota at the proposed site and the need for the site. Completion of this evaluation process could take as long as 2 years. This process would apply to the South Bay and Hunter's Point disposal sites. The Alcatraz site is "established", and is presently used for disposal of dredged material. Aquatic disposal at any of these sites would also require certification by the Regional Water Quality Control Board, San Francisco Bay Region, following approval by the Environmental Protection Agency (31).

c. Air Quality. Disposal operations at any of these aquatic sites would release pollutants, such as sulfur dioxide, particulate and nitrogen oxide, into the atmosphere. This would not have a significant adverse impact on air quality. Considering the points of origin and the usual dispersal characteristics of air pollutants, the impact on air quality should be lower than that experienced at land disposal alternatives. There are not any populated areas in the Bay, except for Treasure and Yerba Buena Islands. Disperal characteristics of air pollutants are such that by the time that aquatic disposal-related pollutant concentrations would reach onshore populated areas, the concentrations would be lower than at the points of origin (1).

d. Insignificant Impacts. Aquatic disposal would not have an impact on topography, geologic hazards, water circulation or noise.

5. Effects on the Biotic Environment.

a. Vegetation. Aquatic disposal would not have an adverse impact on vegetation.

b. Shellfish and Other Invertebrates. The most important physical impact of suspended solids, generated by disposal activities, on aquatic organisms is interference with the water transport mechanism. Many invertebrates are filter feeders; they pump water through their body, selectively filtering out those particles that would be digestable and rejecting non-food particles. Most shellfish fall into this category, as do the sponges and many benthic worms. Increasing the suspended solids concentration can cause the filtering apparatus to become clogged, or if the level is too severe, the organism may cease filtering altogether. This is one of the mechanisms by which dredged material may be harmful to benthic life (1). Disposal of dredged material would also smother benthic life and displace organisms at the site.

(1) South Bay Site. Aquatic disposal of dredged sediment could be detrimental to benthic organisms in the disposal area, but the Stanford Research Institute found no evidence of adverse effects at the South Bay disposal site where disposal of dredged material occurred, following the first census conducted in March 1973 (11). Post-disposal samples revealed little change in numbers of organisms and the dominant organisms sampled before disposal continued to dominate the population numbers subsequent to disposal (1). However, about seven months had passed from the time of disposal to the time of population censusing, a lapse of time probably sufficient to obscure any immediate effects. In addition, March 1973 appears to have been a poor reference period because the sediment in the southern portion of the bay was not as well populated then as during the other sampling months (11).

(2) Hunter's Point Site. Due to the fact that this site was seldom used for the disposal of dredged material and that disposal did not occur during the Corps' Dredge Disposal Study, a specific description of impacts on shellfish and other bottom life cannot be made here. General impacts were included at the beginning of this section on shellfish. Disposal would probably change the type of benthic community at this site, at least on a short-term basis.

(3) Alcatraz Site. This site is frequently used for disposal of dredged material. The continued use of this site for disposal of material has probably had some effect on the benthic community, but because the site is in a high energy area, it is difficult to determine what effect disposal has had. The environmental factors, such as strong currents and scouring action, are probably more of a governing factor than disposal of dredged material on the benthic community of this site.

c. Fish. As mentioned earlier, one of the most important physical impacts of suspended solids on aquatic organisms is interference with the water transport mechanism. The extent of interference is dependent upon the type of gills or filtering apparatus. Plankton-feeding fish characteristically have long, thin gill rakers which are easily clogged by sediment particles. Bottom dwelling fish are more adapted to turbid conditions and do not posses gill modifications. However, most any type of gill can become covered with silt, impeding the passage of oxygen to the fish, and preventing normal loss of waste material from the gill surface. Gill tissue may also become thickened from long exposure to high turbidity. Lack of sufficient oxygen is the major result of the impairment of the flow of water across the gills of fish, and this can result in mortality (1). A fish experiencing respiratory distress will begin random movements which may carry it into non-turbid waters so that the gills can be cleaned of sediment. Open water

species, such as striped bass, appear to tolerate low dissolved oxygen levels for short periods of time, however, sub-lethal effects, such as impairment of reproduction or feeding, are not known (33). An increase in turbidity due to disposal could have some impact on the development of larval fish (45). The impact of disposal on adult fish would be minimal compared to the impact on shellfish and other bottom invertebrates. Removal and displacement of shellfish would have an adverse impact on fish such as the starry flounder and perch, which feed on these invertebrates.

d. Rare and Endangered Species. Aquatic disposal of dredged material would not have an adverse impact on rare or endangered species.

6. Effects on the Socio-Economic Environment.

a. Employment. Disposal of dredged material at an acceptable site would have a beneficial impact on commerce and navigation, and thus on employment, by allowing the maintenance of the Redwood City Harbor Project to be performed.

b. Commerce/Navigation. Disposal at any acceptable disposal site would have a beneficial impact on commerce and navigation by allowing the continued maintenance of the Redwood City Harbor channel. Disposal of dredged material at the South Bay aquatic site would probably result in most of the material remaining in the South Bay. Some of this material may become redistributed in the San Bruno Shoal channel and this may have an adverse impact on maintenance of this part of the Redwood City Harbor Project.

c. Existing Land Use. The continuation of commerce and navigation at the Redwood City Harbor Project would have a significant impact on existing land use in the study area, which is closely tied to shipping and maritime activities. The discontinuation of maintenance dredging would probably result in relocation of the Port facilities, including tenants and a change in land use for the immediate area.

d. Private Property/Property Values. A change in land use, as a result of discontinuation of maritime activities, would result in a change in property values. Thus, continuation of existing land use would have a significant impact on property values and private property.

e. Tax Revenue/Local Government Finance. The Port of Redwood City presently contributes funds to the City of Redwood City through operation of maritime facilities. The continuation of the Port of Redwood City would have a significant impact on local government finance.

f. Aesthetic/Visual Values. The increased turbidity which occurs during disposal activities would have a slight, short-term, adverse, visual impact for persons out on the bay.

g. Insignificant Impacts. This alternative would not have any significant impact on cultural resources, farmland, soils, community growth, or recreational opportunities.

D. LAND DISPOSAL ALTERNATIVES

As for the aquatic disposal alternatives, the impacts for these five alternative land disposal sites are combined in one section, due to the similarity of the effects on the environment. However, each alternative is described separately and is a separate "entity." Unless otherwise stated, the impacts described apply to all of these alternatives. An impact tree, tracing the cause and effect relationships for these alternatives, is shown on the following page. The significant impacts are discussed below. This tree is based on the environmental matrix in Section 2.

1. Bair Island - Port of Redwood City Site.

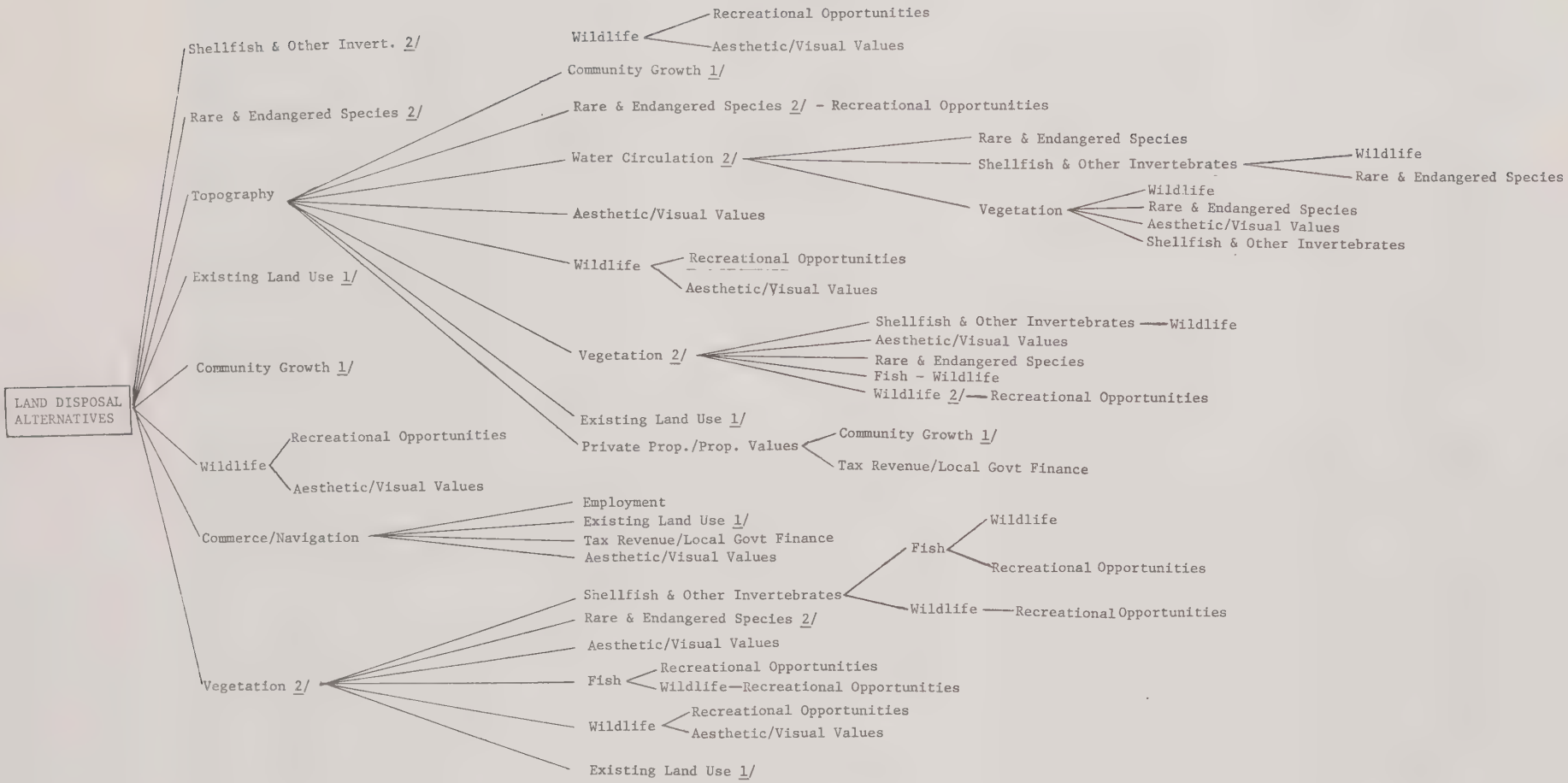
This alternative would involve the placement of dredged material on land owned by the Port of Redwood City, on Bair Island. This alternative land disposal site is 135 acres in size and is bounded by the semi-circular shaped Deepwater Slough on the north and west and by Redwood Creek on the southeast (refer to Plate 8). A hydraulic pipeline dredge would probably be used to dredge the Redwood Creek channel and to pump the material onto this site.

Based on field observations, it appears that utilization of this site would require construction of a levee along the entire "interior" side of Deepwater Slough. Contrary to information contained in other reports, Deepwater Slough extends around the southern end of this site, but is closed off to Redwood Creek. A levee cuts across Deepwater Slough from the Cedra Properties' land to the abandoned salt evaporators located to the west of this site (please refer to Plate 5). However, construction of another levee would be required on the "interior" side of Deepwater Slough, so as not to interfere with the drainage and tidal characteristics of Deepwater Slough and adjacent marsh areas.

Construction of the required levee could utilize material dredged from Deepwater Slough or excavated from the interior portion of the site. The construction material would be placed landward from the slough on the site, in order to build a levee along the interior side of Deepwater Slough. The land disposal area would then be about 115 acres in size (3).

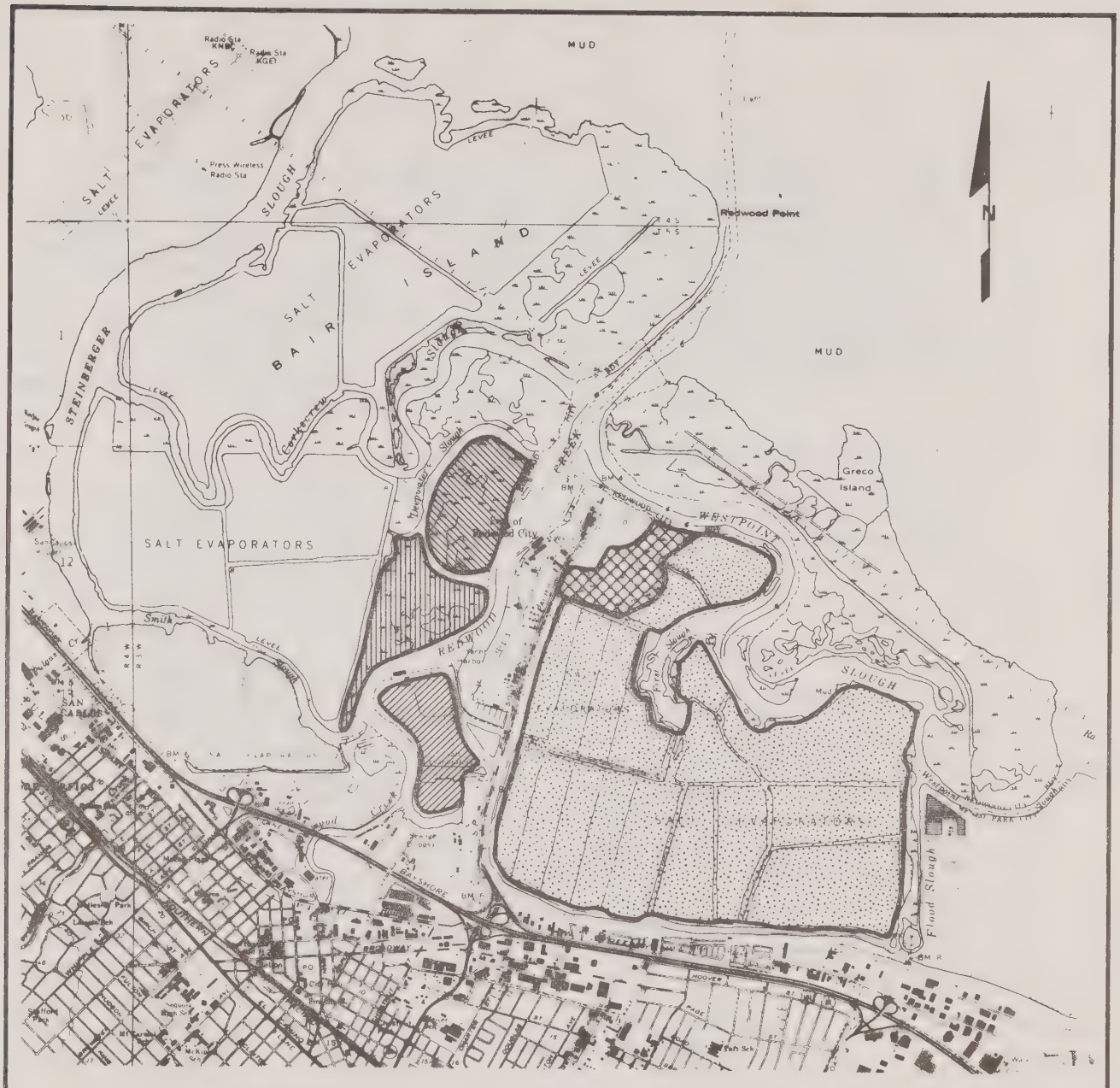
FIGURE 2: IMPACT TREE

LAND DISPOSAL ALTERNATIVES




The lines in this illustration should be read as:
_____ has a significant effect on ...

1/ A change in this factor would result in significant impacts on the entire system.
2/ The significance of this impact differs for some of the alternatives, refer to Section 3.




LEGEND

- Bair Island – Port of Redwood City Site
- Bair Island – Cedra Properties Site
- Leslie Salt Company's Wash Ponds and Salt Stack Site
- Ideal Basic Industiries Site
- Leslie Salt Company's Evaporator Pond Site

1000 0 2000 4000 6000 8000

SCALE IN FEET

ENVIRONMENTAL STATEMENT

SAN MATEO COUNTY CALIFORNIA

# LOCATION OF LAND DISPOSAL ALTERNATIVES

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
FILE NO.

TO ACCOMPANY REPORT
DATED APRIL 1978

PLATE 8

2. Bair Island - Cedra Properties Site.

This alternative includes disposal of dredged material on land owned by Cedra Properties, Inc., located south of the Port of Redwood City site on Bair Island. This 110 acre site, shown on Plate 8, is bounded by Redwood Creek on the southeast, by Leslie Salt Company's abandoned evaporator ponds on the west, and by Deepwater Slough on the north. This site is partially protected by dikes. Thus, disposal at this site would require construction of levees, probably utilizing native borrow material from the site, in order to contain the dredged material on the site. A hydraulic pipeline dredge would probably be used to dredge and pump the material to this site.

The U.S. Geological Survey (USGS) is considering using all or a portion of this site for disposal of dredged material from maintaining the access channel to their pier, located adjacent to the Leslie Salt Company's salt stack. The use of this site by USGS would reduce the capacity of the site to hold dredged material from maintenance of the Redwood City Harbor Project.

3. Leslie Salt Company's Wash Ponds and Salt Stack Site.

This disposal site is located to the south of the land owned by Cedra Properties, Inc. on Bair Island and across Redwood Creek (refer to Plate 8). Twenty acres of the site, which is about 107 acres in size, is covered with the Leslie Salt Company's salt stack. A hydraulic pipeline dredge would probably be used to dredge and pump the material from the channel to this site. A portion of this site is enclosed by dikes. Utilization of this site would require construction of additional dikes, utilizing native borrow material from the site, in order to completely contain the material on this site. Portions of this site have been considered in the past for disposal of dredged material, but have never been used (1).

4. Leslie Salt Company's Evaporator Pond Site.

This alternative includes disposal of dredged material at some or all of the evaporator ponds owned by the Leslie Salt Company, located on the eastern side of Redwood Creek. The area under consideration is bounded on the north by Westpoint and First Sloughs, on the east by Flood Slough, by the Bayshore Freeway on the south, and by Harbor Boulevard on the west, as shown on Plate 8. Disposal of dredged material may require elevation of the dikes surrounding the ponds. The construction material could be taken from the land in this site.

H.K.S., Inc., a planning, architecture and environmental design firm, prepared a Baseline Environmental Impact Report (EIR) for the City of Redwood City on "Alternative Development Concepts for 2,135 acres in and adjacent to the City of Redwood City," in November 1977 (6). The five alternative plans presented in this report range from extensive marsh creation to extensive placement of fill in the area within this site (6). When all of the alternatives are analyzed, one realizes that

the potential exists for filling all of the salt ponds in this area. Thus, this land disposal alternative encompasses the entire area, described above.

There are many possible variations within this alternative. As mentioned above, disposal could occur in one or more of the individual salt evaporator ponds on this site. Three separate "sites" located within this alternative were proposed by the Port of Redwood City and have been considered in the past. These sites are numbered 4, 5 and 6 on Plate 9. Sites "4" and "5" are located adjacent to the Port's facilities and Site "6," known as the "bittern pond site," is located adjacent to Westpoint and First Sloughs.

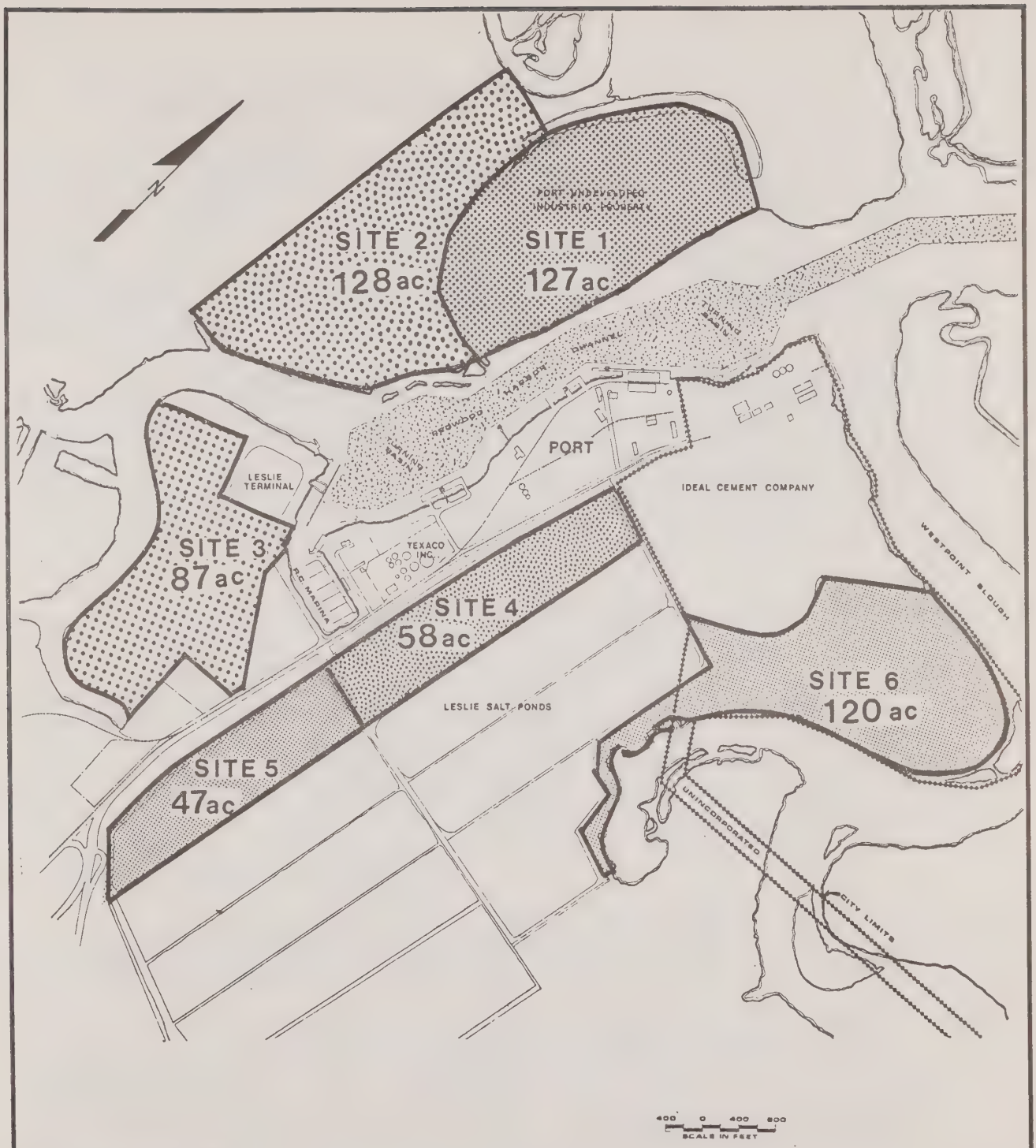
5. Ideal Basic Industries Site.

This alternative would place dredged material on land owned by Ideal Basic Industries, Inc. Fill could be placed on this site under one or more of the alternatives presented by HKS, Inc. in the "Final EIR on Alternative Development Concepts for 2,135 Acres in and Adjacent to the City of Redwood City" (6). This site is shown on Plate 8 and is located immediately south of Westpoint Slough, near its confluence with Redwood Creek. It is bounded on the south and east by the Leslie Salt Company's evaporator and bittern ponds. A hydraulic pipeline dredge would probably be used to pump the material to this site. Construction of some dikes may be required to contain the dredged material. Native borrow material from the site would probably be used to construct any required levees.

6. Other Land Disposal Alternatives.

An alternative use of the land disposal sites identified in the above sections would be as "recycling sites" for dredged material. Dredged material has a high water to sediment ratio when pumped to the site via a hydraulic pipeline dredge. The dredged material tends to form a crust on the surface, which prevents evaporation of water and dessication of the material. The dredged material could be worked so as to increase the exposure of the sediment to the air and thus speed up the dessication process. The dredged material could then be used for commercial fill material, either within the study area or shipped to other construction sites.

Dames and Moore, consulting engineers, are currently researching the potential use of the Leslie Salt Company's wash pond area near the salt stack and the evaporator ponds, located immediately east of Harbor Boulevard, for this purpose (37). The "dredged material research program", conducted by the Corps of Engineers' Waterways Experiment Station (WES) in Vicksburg, Mississippi, is also researching various methods to improve dessication of the dredged material.




SITE OWNERSHIP

1 Port of Redwood City

2 Cedra Properties

3–6 Leslie Salt Company

SOURCE: Port of Redwood City

ENVIRONMENTAL STATEMENT

SAN MATEO COUNTY CALIFORNIA

LAND DISPOSAL SITES
PROPOSED BY THE PORT

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN: FILE NO.
TRACED: TO ACCOMPANY REPORT
CHECKED: DATED APRIL 1978

PLATE 9

7. Effects on the Physical Environment.

a. Topography. Placement of dredged material on any of the alternative land disposal sites would change the topography of the site. In general, the sites would be higher, with a final elevation of about 14 feet above MLLW, following disposal and settlement of the dredged material. Any variance in the existing topography of the sites, such as those on Bair Island, would be replaced by a flat, uniform surface. Following consolidation of the dredged material, the surface of the site could be graded to provide some variation in surface elevations.

b. Geologic Hazards. Emplacement of hydraulic fill over bay mud would create an unnatural loading condition. The underlying and adjacent material would then be free to respond plastically. This response is known as mud wave formation or heave. If large areas are hydraulically filled at slow uniform rates, this phenomenon could be restricted or prevented. If filling occurs sporadically or is confined to restricted cells, outward lateral flows of plastic mud could occur (1).

Some settlement could be expected to occur following placement of dredged material. The exact amount of settlement cannot be predicted, since subsurface data are not available (1). However, based on engineering judgment and experience relating to areas of similar conditions, it is estimated that about three or four feet of settlement can be expected at these sites, with approximately eight feet of dredged material. The area beneath the Leslie Salt Company's salt stack is not expected to undergo further consolidation. Future plans for development would have to consider settlement. Although settlement with one year's dredged material would be less than a foot, continued disposal would result in continued settlement (1).

An earthquake could cause ground (fill) failure, the severity and extent of which would depend on many factors at the time (1). The site may be susceptible to liquefaction during seismic activity (2).

The water content of the dredged material would probably be around 85 percent and the material would require dewatering. Since dredged material can form a crust which prevents the complete dessication of lower layers of silts and clays, various methods may be required to accelerate drying, if the site were to be developed in the near future. The material would then require conventional consolidation before further development could occur (6).

c. Water Circulation. Impacts on water circulation have only been identified for the Cedra Properties and Port sites on Bair Island and for the Ideal Basic Industries site. Portions of each of these sites are intertidal and thus provide storage for high tides. Placing dredged material on these sites raise the land elevations (topography) on these sites, thus reducing the storage capacity for high tides. Disposal of dredged material on the Leslie wash pond/salt stack and evaporator pond sites would not affect water circulation.

d. Sedimentation. Impacts on sedimentation have not been identified for any of the land disposal alternatives. Construction of levees for these alternatives may require dredging, which could affect local sedimentation processes. Dredging Deepwater Slough to provide construction material for the levee on the Port site would not affect sedimentation in the slough, since it is not connected to Redwood Creek at present.

e. Water Quality. Sediment analysis was conducted on 25 samples taken in nine locations within the existing Federal navigation channel in February of 1977 for the Port of Redwood City. These samples were taken prior to maintenance dredging which occurred in March and April of 1977. The analysis indicates that the material was "unpolluted," when compared to EPA's criteria for disposal of dredged material on land sites. The material should be retained by dikes, but they would not have to be impermeable, based on this data (refer to Appendix B). Prior to any future maintenance dredging, additional sediment samples may be required. The return flow from this site would be monitored according to EPA's criteria so that the maximum discharge of settleable solids would be 1.0 ml./hour or less, if required by State or local agencies (5).

The impacts of dredging and disposal have only been identified for the Port's site on Bair Island. Dredging which could be required for construction of the levee for this alternative would have a temporary adverse impact on water quality in Deepwater Slough. Turbidity in the water zone would be increased by a small amount, dissolved oxygen levels would drop temporarily, and possibly some heavy metals and other pollutants, which may be present in the sediment in Deepwater Slough, might be released in minute amounts into the water column in this slough. If dredging is required for construction of dikes for the other alternatives, similar impacts, such as an increase in turbidity, would be expected.

Based on two borings taken in Deepwater Slough by Madrone Associates for the Port of Redwood City, the soils in the slough are considered unpolluted when compared to the Environmental Protection

Agency's (EPA) criteria for disposal of dredged material (3, 5). The sediment analysis indicates that these soils can be placed in areas susceptible to wave erosion, as in the dike (refer to Appendix B).

f. Air Quality. Operation of dredging equipment to transport the dredged material to these alternative land disposal sites would have a minor, adverse impact on air quality in the immediate area. The removal of marsh vegetation for the alternatives on Bair Island and for the Ideal Basic Industries site would have minor adverse impact on air quality, since marsh vegetation produces oxygen and may have a role in converting toxic carbon monoxide to non-toxic carbon dioxide (3). Of much greater concern would be potential secondary impacts on air quality from possible development of the sites, once the dredged material is consolidated.

g. Noise. Operation of dredging equipment and perhaps, later, consolidation equipment, would have a short-term adverse impact by raising noise levels in the surrounding area. Future development on any of these land sites, except for the Leslie Salt Company's wash pond and salt stack site, may have secondary adverse impacts on wildlife in adjacent marshes located on Bair and Greco Islands (34). The Leslie Salt Company's salt processing operations near the salt stack are presently contributing to the noise level in the study area.

8. Effects on the Biotic Environment.

a. Vegetation. Following disposal of dredged material on any of the land disposal alternatives, some upland vegetation may become established, however, the frequency of disposal and ultimate use of the site for other purposes may limit its extent. Recolonization of the soils on the two Bair Island sites and Ideal site with marsh vegetation would not occur following disposal of dredged material due to the high, final elevations of these sites and to the lack of tidal inundation, once the sites are filled.

(1) Bair Island - Port of Redwood City's Property. Placing dredged material on the Port's property on Bair Island and construction of the dike would have a significant adverse impact on at least 70 acres of marsh habitat, located adjacent to Deepwater Slough (6). This marsh vegetation would be permanently removed by this action. The marsh consists mainly of pickleweed and marsh rosemary, with patches of cordgrass in Deepwater Slough. The marsh does receive tidal inundation and provides habitat for a variety of wildlife including birds, rabbits and endangered species. The decaying marsh vegetation,

as detritus, provides food for primary producers, such as shellfish, important in the food web (3). Mitigation for the loss of this marsh habitat would be required, if this alternative is given further consideration.

(2) Bair Island - Cedra Properties Site. Disposal of dredged material on the Cedra Properties site would remove a significant amount of marsh vegetation, primarily pickleweed. The site is not completely vegetated, however, there is a dense growth of pickleweed with some salt grass, Frankenia and Spergularia along Redwood Creek. A less dense growth of marsh vegetation is found in the middle portion of the site. Higher clumps of dredged material along Redwood Creek support grasses and coyote brush. This upland-type vegetation would be removed, but would become reestablished following disposal of dredged material. The loss of marsh vegetation would be permanent and more significant. Mitigation for the loss of this marsh habitat would be required, if this alternative is given further consideration.

(3) Leslie Salt Company's Wash Ponds and Salt Stack Site. Disposal of dredged material on this site would have little impact on vegetation resources on the site, which is very sparsely vegetated (1).

(4) Leslie Salt Company's Evaporator Pond Site. Disposal of dredged material on all or portions of this site would remove vegetation such as pickleweed, brass buttons and grasses, bordering the interior sides of some of the dikes surrounding the ponds (6). Disposal of dredged material would eliminate the possibility of restoring these ponds to marsh habitat. The value of marsh habitat to wildlife and other life processes in the Bay has already been discussed.

If dikes surrounding the ponds must be raised in order to contain the wet volume of dredged material, the vegetation along the tops of the dikes would be removed, but would later become reestablished. The marsh vegetation on the exterior side of the dikes along Westpoint and First Sloughs would be removed, and would probably become reestablished.

The value of any upland habitat on the site, once filled, would depend on the future use of the site. Mitigation would be required for this alternative, if it is given further consideration.

(5) Ideal Basic Industries Site. Disposal of dredged material would remove pickleweed vegetation, which covers most of this site. This area is subject to tidal action through a culvert under the dike adjacent to Westpoint Slough. Thus, placing fill on this site would remove a fairly large pickleweed marsh, subject to tidal action, and would require mitigation.

Depending on the nature of land use following consolidation, adverse effects on marsh vegetation on Greco Island could occur. Assuming that the area was used for Port facilities, Westpoint Slough might require dredging and the increased ship or boat traffic may erode the marsh on Greco Island (34).

b. Shellfish and other Invertebrates. Disposal of dredged material on the Leslie Salt Company's wash ponds or evaporator pond alternative sites would not have any impact on shellfish or other benthic life. Removal of the evaporator ponds from salt production use would have an adverse impact on the brine shrimp and flagellates in the ponds, which provide food for a variety of wildlife.

(1) Bair Island - Port of Redwood City Site. The possible dredging of Deepwater Slough for construction of the dike surrounding this site would have an adverse impact on the benthic community in Deepwater Slough. Trawls and beach seine surveys conducted by the U.S. Fish and Wildlife Service in 1975 and 1976 in other portions of the study area and in Corkscrew Slough indicate the presence of bentnose and littleneck clams, mud crabs, and mud snails (35). It can be assumed that these and other species inhabit Deepwater Slough and that they would be adversely impacted by this activity (36).

Disposal of dredged material from past maintenance dredging of Redwood City has occurred in portions of Deepwater Slough (37). The benthic community has probably become reestablished since that disposal, and the length of time required for reestablishment cannot be predicted. Some studies indicate that disposal and dredging change the nature and make-up of the benthic community (1).

(2) Bair Island - Cedra Properties Site. No information is available on the status of shellfish and other invertebrates on the non-vegetated areas on this site. Portions of the site are muddy areas, covered with water, the source of which is unknown. The site appears to receive some tidal action from Deepwater and/or Corkscrew Sloughs. Some of this water could also be ponded from heavy rains. Large numbers of shorebirds and waterfowl, such as willets, dunlins, sand pipers and pintails, were seen feeding in these exposed areas, possibly on shellfish or other invertebrates, during field observations in January of this year.

(3) Ideal Basic Industries Site. Disposal on this site would not have any direct impacts on shellfish and other benthic life. However, development of this site could have secondary adverse impacts on shellfish and invertebrates in Westpoint Slough, if future development on the site required dredging of Westpoint Slough. The nature of land use following consolidation of the dredged material would dictate the nature of the secondary impacts.

(4) Removal of marsh vegetation on the latter 3 sites would decrease detritus and nutrients entering the mudflats from the marsh. This would have an adverse impact on shellfish and other invertebrates.

c. Fish. Disposal of dredged material on the Leslie Salt Company's wash pond and evaporator pond sites would not have any impact on fish. The removal of marsh vegetation by disposal of dredged material on the Bair Island and Ideal alternative sites would decrease the nutrients and detritus being contributed by the marsh to the food chain, via shellfish and other invertebrates. This would have an adverse effect on the fish in the study area and in the Bay. The cumulative impact of removing marshlands is very significant.

(1) Bair Island - Port of Redwood City Site. The potential dredging of Deepwater Slough in order to build a levee on this site would have an adverse impact on fish, such as the shiner surfperch, topsmelt, northern anchovy, English sole, three-spined stickleback and others which would be expected to inhabit this slough (35, 36) (refer to Appendix C). The increase in turbidity, decrease in dissolved oxygen and mechanical effects of dredging would have an adverse impact on these fish, especially during certain times of the year. The greatest number of fish appear to use the sloughs in this area between April and October. These times should be avoided to minimize impacts on fish, if borrow material for dike construction is obtained from Deepwater Slough.

(2) Ideal Basic Industries Site. Following disposal, possible, future development of Port facilities on this site may require dredging Westpoint Slough. This activity would have an adverse impact on fish in this slough (34).

d. Wildlife.

(1) Bair Island - Port of Redwood City Site. Removal of the benthic community in Deepwater Slough and the marsh vegetation and mudflats on this site (if borrow material is obtained from this slough) would have a significant adverse impact on the many shorebirds, terns, grebes, avocets and other birds and wildlife which use these areas. Marsh vegetation provides habitat as well as food for wildlife both directly and indirectly, through the food chain in the Bay.

Destruction of the upland habitat, primarily coyote brush and grasses, would have an adverse impact on jackrabbits, meadow mice, marsh hawks and perhaps vagrant shrews and other wildlife, such as egrets, which may use the coyote brush for nesting (3). If the disposal site remained undeveloped, this upland habitat would eventually become reestablished. However, if the disposal site were to be developed, the loss of upland habitat would be permanent.

Dredging Deepwater Slough, if required to provide borrow material for dike construction, and disposal operations would have a temporary, adverse impact on wildlife nesting and feeding on adjacent marsh areas on Bair Island, which are part of the S.F. Bay National Widllife Refuge. Any future development on the site would have more adverse, long-term effects on adjacent marsh communities.

Placing fill on this site and later developing it would require the construction of access roads on Bair Island, which presently can only be reached by boat or helicopter. This potential intrusion of humans as well as feral cats and dogs would have an adverse impact on waterfowl and other birds which nest on Bair Island (34). Birds nesting near areas of human disturbance have had problems with predation by Norway rats (12).

(2) Bair Island - Cedra Properties Site. Removal of the marsh vegetation and "non-vegetated, mudflat" areas on this site would have a significant adverse impact on waterfowl, shorebirds, rabbits and other wildlife which use the site. During field investigations, large numbers of shorebirds and some black-necked stilts were observed feeding and resting on the slightly higher portions of the "non-vegetated" areas on this site. The impact on this kind of wildlife would be the most significant. The lower, non-vegetated areas were holding either tidal or ponded water during field investigations in January, 1978. Very large numbers of waterfowl were observed in these ponded areas.

Secondary impacts on wildlife caused by providing access to this site, following disposal, would be significant. Please refer to the last paragraph of paragraph d.1. on the Port site.

(3) Leslie Salt Company's Wash Ponds and Salt Stack Site. Disposal of dredged material on this site would have a moderate adverse impact on wildlife. The ponds, used to wash the salt, hold water seasonally and have some value for wildlife, particularly waterfowl. A large group of birds, including black-necked stilts, avocets, scaup, dowitchers and godwits, were observed using these ponds by Fish and Game personnel during February 1978 (46).

(4) Leslie Salt Company's Evaporator Pond Site. Removal of these salt ponds from salt production-use would have a significant adverse impact on waterfowl and shorebirds. Water-oriented birds feed in and rest on the salt ponds and many species nest on the dikes surrounding the ponds. The value of these salt ponds for wildlife has been discussed in the environmental profile. The ponds not in use would collect and retain precipitation seasonally, but would not support the flagellates and brine shrimp upon which the birds feed, since the shrimp require a saline environment.

Disposal of dredged material on this site, following abandonment of salt production, would have a moderate impact on wildlife. The ultimate use of the site, once filled, would determine the future value of the site for wildlife. Upland habitat differs in value for wildlife from salt pond habitat.

The loss of the potential to restore the ponds to marsh would be significant for waterfowl and other wildlife. Future development of portions of the site adjacent to Westpoint Slough could have significant adverse impacts on wildlife in the S.F. Bay National Wildlife Refuge on Greco Island.

(5) Ideal Basic Industries Site. Removal of pickleweed vegetation would have an adverse impact on birds and other wildlife which may use this site. Secondary impacts on wildlife present on Greco Island could be adverse, depending on the nature of future land use on the site.

e. Rare and Endangered Species. Placing dredged material on the Leslie Salt Company's wash pond and salt stack site would not adversely affect any rare or endangered species in the study area. In general, removal of marsh vegetation on the Bair Island and Ideal sites would indirectly affect rare and endangered species, described below, through removal of primary producers in the food chain. Removing this marsh vegetation and raising the elevation of these sites so that tidal inundation could not occur, following disposal, would preclude the reestablishment of most of the water-oriented endangered and rare species, discussed below.

Disposal may have an adverse impact on several plant species which may inhabit these three alternative sites and whose status is described in the environmental profile section. These plants are: the Point Reyes bird's beak and Gairdner's yampah (refer to Table 5). It seems most likely that the Point Reyes bird's beak, which grows in coastal salt marshes and has been identified in the U.S. Geological Survey quadrangle map entitled Redwood Point, would be found on the Bair Island and Ideal sites. A survey by a well-qualified botanist may be required at a future time, if these sites are considered further.

(1) Bair Island - Port of Redwood City and Cedra Properties Sites. Although trapping studies have not been conducted on the Port site, it seems very likely that the endangered salt marsh harvest mouse inhabits the pickleweed marsh on this site (17). Trapping studies conducted in February 1978 yielded one endangered salt marsh harvest mouse on the Cedra Properties site (22). Since there is an extensive pickleweed marsh on both the Port and Cedra sites, it seems very probable that the endangered California clapper rail lives on these sites (17). The endangered California brown pelicans and rare California black rails are found on other portions of Bair Island; their status on these sites is uncertain. The disposal of dredged material may have an adverse impact on these endangered species. Disposal on the Cedra site would definately have an adverse impact on the salt marsh harvest mouse.

The endangered California least tern nests in the abandoned Leslie salt ponds on Bair Island, owned by the State of California, and may be impacted indirectly by disposal on the Port site.

Future development of the Port site would have an adverse impact on these endangered species living adjacent to the Port land on Bair Island. The future development of Bair Island would require construction of access roads to the site. Presently, Bair Island north of Smith Slough can only be reached by boat. Thus, allowing access to humans as well as feral cats and dogs would probably have an adverse impact on some of these endangered species.

(2) Leslie Salt Company's Evaporator Pond Site. Removal of salt evaporator ponds would have a slight adverse impact on the endangered California brown pelicans and California least terns which feed in the salt ponds. If raising the dikes is required in order to retain the dredged material, this could have an adverse impact on California least terns, which have been observed nesting to the west of Westpoint Slough.

Future development on the salt ponds adjacent to Westpoint Slough could have an adverse impact on the following endangered species found on Greco Island: the salt marsh harvest mouse and California clapper rail.

(3) Ideal Basic Industries Site. This area has not been surveyed for the endangered California clapper rail or the endangered salt marsh harvest mouse. The salt marsh harvest mouse has been trapped by the California Department of Fish and Game across from this site on Greco Island and thus may inhabit this pickleweed zone. The dense marsh vegetation on the site and on the outer side of the levee adjacent to Westpoint Slough may offer appropriate habitat for the salt marsh harvest mouse. Appropriate habitat for the California clapper rail can be found in the marshes bordering Westpoint Slough (15). Three clapper rails were observed in the pickleweed marsh along Westpoint Slough in February, 1972 by the California Department of Fish and Game (15). Disposal may have an adverse impact on these endangered species.

f. Vector Control. Proper design and management of a land disposal site would be required in order to avoid the creation of mosquito breeding habitats. The California Mosquito and Vector Control Association, in cooperation with the Vector and Waste Management Section, California Department of Health, have developed specific criteria to prevent mosquito problems in land disposal areas for dredged material (42). These criteria are based on biological control methods, the aim of which is to establish and maintain a long-term, drainage system to preclude mosquito production. A topographic survey, following subsidence of the site, would be required in order to properly place ditches and drainage structures. Maintenance of ditches, water control structures and levees, as well as disking cracked ground, as necessary, would also be required.

9. Effects on the Socio-Economic Environment.

a. Employment. Disposal of dredged material at an acceptable disposal site would have a beneficial impact on commerce and navigation, and thus on employment, by allowing the maintenance of the Redwood City Harbor Project to be performed. Closing down the Leslie Salt Company's "Redwood City Plant" would probably have some impact on local employment. This proposed shut-down may occur, regardless of the use of the wash pond and evaporator pond sites for disposal of dredged material. Dredging and disposal activities would have an insignificant effect on employment. The ultimate land use of an alternative site could affect employment opportunities.

b. Commerce/Navigation. Disposal of dredged material via a hydraulic pipeline may interfere with ships and boats moving in the harbor. This effect would be temporary and could be minimized by careful placement of the pipeline.

Disposal of dredged material at an acceptable site would have a beneficial impact on navigation by allowing future maintenance dredging of the channel. It would also ensure continued commercial activities dependent on local shipping.

c. Cultural Resources. In compliance with Section 106 of the National Preservation Act of 1966 (16 USC 470 (f)), the most recent listings of the National Register of Historic Places (Federal Register, February 1977, with monthly supplements) has been consulted and determination has been made that no National Register property, or property determined eligible for inclusion in the National Register, shall be affected by placing dredged material on these sites.

Implementation of the Leslie salt pond or wash pond/salt stack alternative sites would have an adverse affect on the salt evaporator ponds, as cultural resources, by rendering the normal recovery process inoperable. However, these resources are not of sufficient merit to warrant inclusion in the National Register of Historic Places and the resulting resource loss would not be significant. Adequate numbers of operable examples of commercial salt recovery of a complexity and condition superior to the subject cases exist as representative samples of this form of economic activity.

In compliance with Executive Order 11593, "Protection and Enhancement of the Cultural Environment" issued May 13, 1971, the State Office of Historic Preservation has been consulted and determination has been made that no State Historical Points of Interest or State Historical Landmarks will be affected, either adversely or beneficially, by these alternatives. Prior to recommendation of a final alternative, a cultural resource reconnaissance would be performed.

d. Existing Land Use. Disposal of dredged material on the Leslie evaporator and wash pond sites would have an impact on land use by changing it from salt production use to use of the land for development. The remaining alternatives for land disposal would change land use from marsh/wildlife use to use of the land for development.

The continuation of commerce and navigation at the Redwood City Harbor Project would have a significant impact on existing land use in the study area, which is closely tied to shipping and maritime activities. The discontinuation of maintenance dredging would probably result in relocation of the Port facilities including tenants, and a change in land use for the immediate area.

e. Farmland/Soils. Disposal of dredged material on any of these sites would not have an impact on prime farmland. Placing dredged material on the Leslie Salt Company wash and evaporator pond sites would remove the lands from salt production use and thus, from the Williamson Act.

f. Community Growth. All of the land disposal alternatives would have the potential for impacting growth and future development. Following consolidation of dredged material and perhaps the addition of additional material from another source, the sites would be suitable for future development. The nature of this development depends on the outcome of land use planning presently underway in the Redwood City Waterfront "Special Area Plan" (refer to Section 4, Paragraph D). Community growth in the study area would probably have secondary impacts on many of the physical, biological and socio-economic factors discussed in this working paper. These secondary impacts have not been addressed in this study.

g. Private Property/Property Values. Placing dredged material on any of the land disposal alternatives, except the Port of Redwood City site would have an impact on private property. For each alternative, the monetary value of the land would increase. If the private land sites were purchased by the Port of Redwood City, a shift from private property to "quasi" public property would occur. This transfer would have an impact on the owners, the Leslie Salt Company, Cedra Properties, Inc., or Ideal Basic Industries.

A change in land use, as a result of discontinuation of maritime activities, would result in a change in property values. Thus, continuation of existing land use would have a significant impact on property values and private property.

h. Tax Revenue/Local Government Finance. The potential increase in the value of all of the land disposal alternative sites, except the Port of Redwood City site, would increase the tax revenue collected by Redwood City and San Mateo County. If the private land

were transferred in some way to the Port of Redwood City, some loss in tax revenue would occur. This potential loss in tax revenue would not have a significant effect on local government finance. Disposal on the Port's land on Bair Island would not affect tax revenues collected by Redwood City or San Mateo County, since the port is exempt from these taxes. Purchase of a land disposal site(s) by the Port would affect local government finance. Removal of the Leslie Salt Company lands from salt production and from the Williamson Act would probably raise tax revenue collected and would affect local government finance, to a small extent.

The Port of Redwood City presently contributes funds to the City of Redwood City through operation of maritime facilities. The continuation of the Port of Redwood City would have a significant impact on local government finance.

i. Recreational Opportunities.

(1) Bair Island - Port of Redwood City and Cedra Properties Sites. These sites are marginally used at present for recreation. Hunters were seen during field investigations on Bair Island, across from the Port site and Deepwater Slough. Naturalists, fishermen, and others interested in wildlife may use these areas, occassionally. More importantly, the marsh vegetation on these sites contributes detritus (food) and nutrients to the Bay estuarine food chain and provides habitat and shelter for fish and wildlife(1). Thus, in an indirect way, these marshes help support sport fishing and hunting in the S.F. Bay and provide habitat for birds and waterfowl including some endangered species, that many people enjoy seeing and studying in the Bay. Disposal on this site would have an indirect adverse impact on recreational opportunities.

(2) Leslie Salt Company's Wash Pond and Salt Stack Site. The Port of Redwood City is proposing to expand the Redwood City Municipal Marina facilities in the triangular-shaped "pond" located south of the existing marina and immediately to the east of this site. If this proposed plan is carried out, this alternative disposal site may become involved in some way with support facilities for the marina expansion. Future development may enhance recreational opportunities, depending on future land use.

(3) Leslie Salt Company's Evaporator Pond Site. The ultimate use of the salt ponds could have an impact on recreational opportunities. The abandonment of the salt production process in Redwood City would indirectly have an adverse impact on recreational opportunities, such as bird-watching, through the adverse impact on waterfowl and shorebirds.

(4) Ideal Basic Industries Site. One of the alternative plans for this area, presented by HKS, Inc., in their Final Environmental Impact Report on Alternative Development Concepts for 2,135 Acres in and Adjacent to the City of Redwood City, includes a marina on the northern

portion of this site, adjacent to Westpoint Slough (6). The development of a marina would obviously benefit recreational boaters. The development of a marina would have many secondary effects on many aspects of the environment, which would require identification at a later time. Destruction of marsh vegetation, through disposal on this site, would have an indirect adverse impact on fishing, hunting, and nature appreciation activities, as in (1) above.

j. Aesthetic/Visual Values. Disposal of dredged material on any of the alternative land disposal sites would change the topography of the sites and in some way would affect the "aesthetic" value of the area. For the alternatives on Bair Island, removal of extensive marsh vegetation would change the visual appearance of a portion of the study area. Removal of the Leslie salt ponds from salt production use would change the visual and "aesthetic" character of a very large portion of the study area.

## E. MARSH CREATION ALTERNATIVES

Two alternatives sites for marsh creation have been identified in the study area. The impacts associated with these alternatives have been combined in one section, due to the similarity of the effects on the environment. However, each alternative is described separately and is a separate entity. Unless otherwise stated, the impacts described apply to both of these alternatives. An impact tree, tracing the cause and effect relationships for these alternatives, is shown on the following page. The significant impacts are discussed below. This tree is based on the environmental matrix in Section 2.

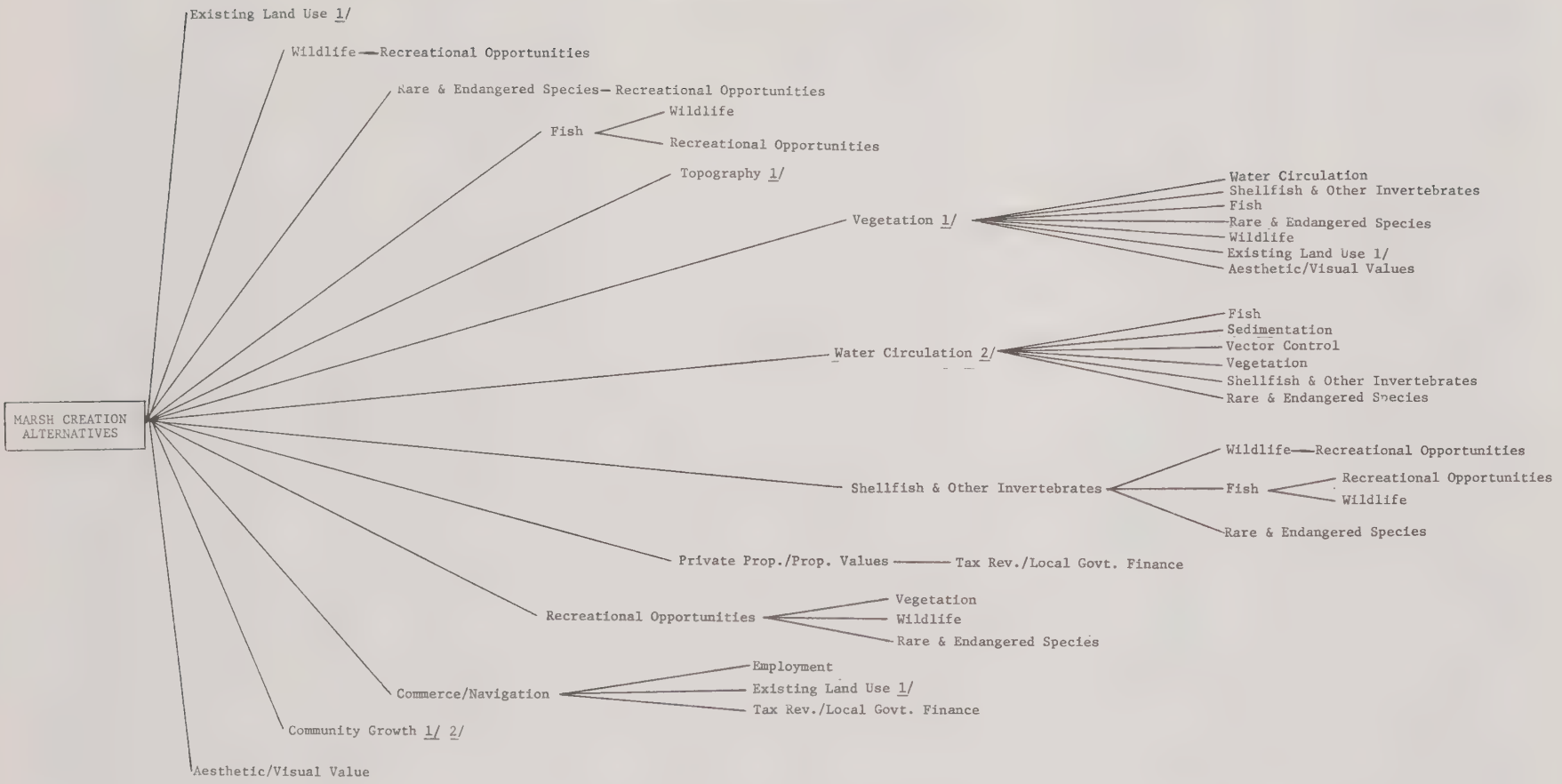
### 1. Leslie Salt Company's Evaporator Pond Site.

This alternative would involve the creation of marsh in all or a portion of the Leslie Salt Company's salt ponds on the southeastern side of Redwood Creek. This area is identical to the area considered for land disposal in the last section and is bounded by Harbor Boulevard, the Bayshore Freeway, and Flood, First and Westpoint Sloughs, as shown on Plate 10. Assuming that the entire site would be converted to marsh land, the internal dikes separating the salt ponds would be removed or breached, prior to placement of any dredged material. Following consolidation, grading and planting of marsh vegetation, the external dikes adjacent to the sloughs would be breached or removed in order to allow tidal circulation.

Information concerning the existing elevations of these salt ponds is scarce. The following information was taken from the Final Environmental Impact Report on the Port of Redwood City and Environs, prepared by H.K.S., Inc. in November 1977 (6). Spot elevations for this site are shown on Plate 10. From this plate, one can see that the elevations range from 8.2 feet MLLW in the bittern pond south of Westpoint Slough and east of the Ideal Basic Industries site, to 4.4 feet MLLW in

FIGURE 3: IMPACT TREE

MARSH CREATION ALTERNATIVES

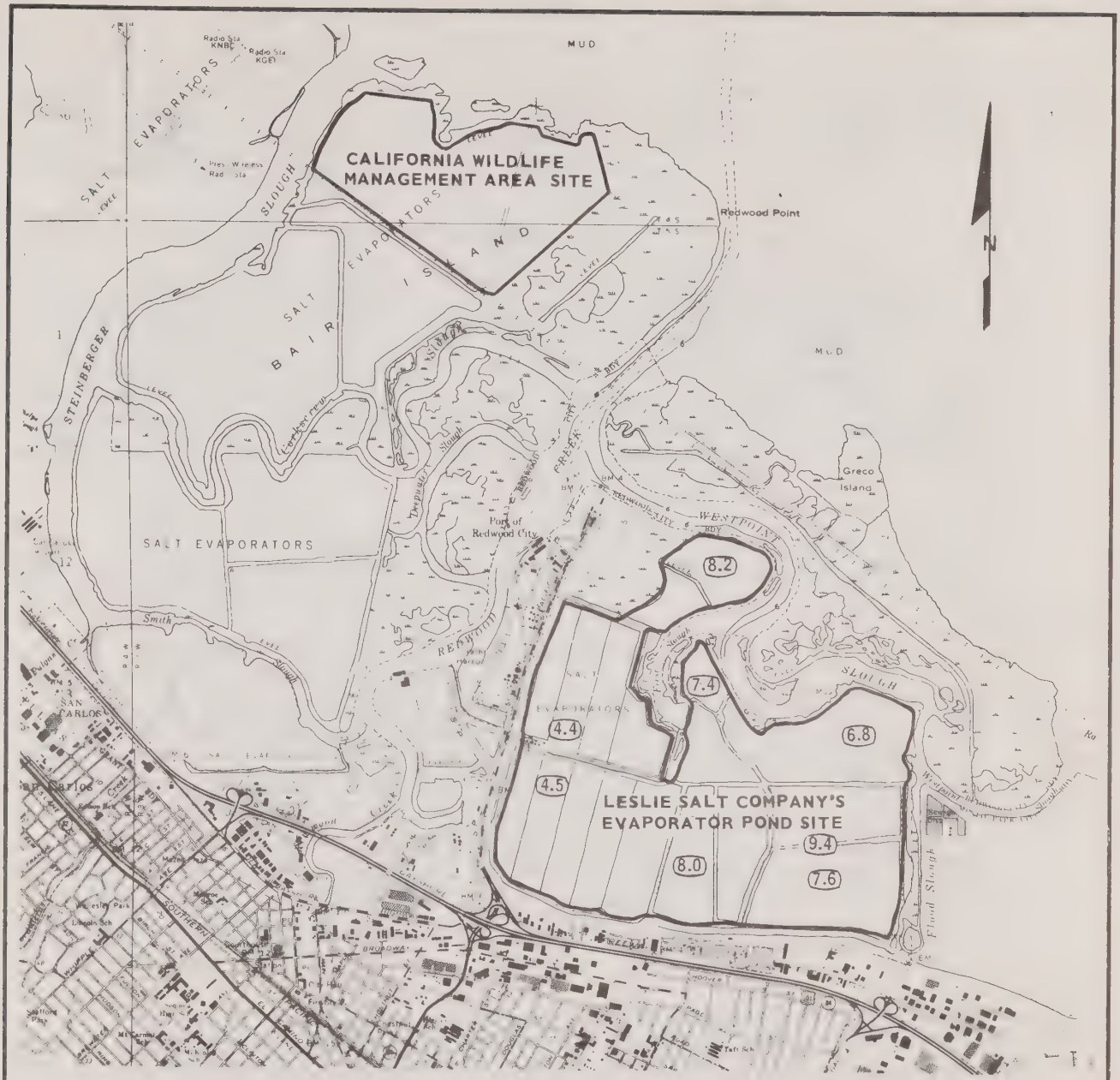



The lines in this illustration should be read as:

_____ has a significant effect on ...

1/ A change in this factor would result in significant impacts on the entire system.

2/ The significance of this impact differs for one of the alternatives, please refer to the appropriate paragraph in Section 3.




LEGEND

(4.4) Existing Elevation (Feet, Mean Lower Low Water)

——— Boundary of Alternatives

1000 0 2000 4000 6000 8000

SCALE IN FEET

SOURCE: H.K.S., Inc. (1976)(6).

ENVIRONMENTAL STATEMENT

SAN MATEO COUNTY CALIFORNIA

LOCATION OF MARSH CREATION ALTERNATIVES

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E FILE NO.

TO ACCOMPANY REPORT DATED APRIL 1978

PLATE 10

the crystallization ponds east of Harbor Boulevard and the port facilities. The pickle and evaporator ponds in the eastern portion of this site, south of Westpoint Slough and west of Flood Slough are slightly higher, having an elevation about 6.8 to 8.0 feet MLLW (6).

2. California Wildlife Management Area Site.

For this alternative, the abandoned salt ponds located in the State of California's Wildlife Management area on outer Bair Island would be restored to marsh. The location of this site is shown on Plate 10. Disposal of dredged material on the site would raise the site elevations to optimum levels for marsh vegetation. Following consolidation, grading and planting, the dikes separating these former salt ponds from the Bay would be breached in several locations in order to provide tidal circulation.

The average existing elevation on this site is assumed to be 4.25 feet MLLW. Surveys would be required in order to determine the exact elevations on this site.

3. Features Common to Both Alternatives.

The "optimum" range for the native species of cordgrass, Spartina foliosa, in San Pablo Bay ranges from 0.0 - 1.0 feet below mean tide level (MTL) to 0.7 - 1.6 feet below mean higher high water (MHHW) (39). Thus, for a preliminary analysis, MTL or 4.25 feet MLLW is considered the lowest elevation for the establishment of cordgrass on dredged material (39). Pickleweed, Salicornia virginica, can be found growing under a variety of soil/moisture conditions; however, the zone in which it is found surrounding San Pablo Bay ranges from 1.0 feet above MTL to 2.5 feet above MHHW (39,40). Therefore, MHHW or 7.9 feet MLLW is chosen as the maximum elevation.

Therefore, the final elevation of the dredged material, after dewatering and consolidation, should range from MTL (4.25 feet MLLW) to MHHW (7.9 feet MLLW). The dredged material should slope towards the Bay, with a slope of 1 vertical : 500 horizontal (40).

The material in Redwood Creek would probably be dredged using a hydraulic pipeline dredge and pumped to sections of the sites so that the material would fan out towards the bay. This may provide the correct elevations; otherwise, grading would be required. A plan would be developed to include sloughs, in order to provide adequate circulation, and perhaps higher, isolated areas or islands to provide wildlife nesting habitat for herons and egrets (41).

Several sources of information indicate that pickleweed would become established in such an area, without planting (40,41). However, cordgrass sprigs could be planted in the lower elevations. A further search of the literature and other sources would be required prior to development of any marsh restoration program.

4. Effects on the Physical Environment.

(a) Topography. The marsh creation alternative would result in a change in the topography of the sites. Both sites are presently fairly flat, being former or existing salt evaporator ponds. The elevations of the sites would be raised, and the surface sloped and planted for these alternatives. Implementation of these alternatives would require careful planning of the topography, which would include elevations of islands and sloughs, as well as slopes of the surface of the site.

(b) Geologic Hazards. Placement of hydraulic fill over bay mud would create an unnatural loading condition. The underlying and adjacent material would then be free to respond plastically. This response is known as mud wave formation or heave. If large areas are hydraulically filled at slow uniform rates, this phenomenon could be restricted or prevented. If filling occurs sporadically or is confined to restricted cells, outward lateral flows of plastic mud could occur (1). Because subsurface data are not available for the Redwood City area, precise estimates of the amount of settlement are impossible.

(c) Water Circulation. Restoring either of these sites to tidal action and creating a marsh would change the water circulation patterns on the sites. The extent of water circulation on each site would depend on the design of interior sloughs to provide circulation. Since the highest, planned elevation of dredged material would be MHHW, most of the site would be inundated during high tides. Converting the Leslie Salt Company's Evaporator Pond Site to marsh would probably have some effect on circulation patterns in Westpoint Slough. Marsh vegetation also tends to reduce water velocities within the marsh, and thus locally "traps" sediment.

(d) Sedimentation. Creation of a marsh on the Leslie Salt Company's Evaporator Pond Site would probably alter sedimentation patterns in adjacent sloughs and possibly marshes located on Greco Island. There would be some movement of sediment on each of the sites with the tidal flow, but the net direction of sediment transport cannot or has not been predicted. Marshes in the bay tend to accrete or collect sediment, so that eventually they would become upland habitat over a long, geological time scale. Working in the opposite direction is the effect of settlement of dredged material and the underlying bay mud.

(e) Water Quality. Sediment analysis was conducted on 25 samples taken in 9 locations within the existing navigation channel in February of 1977 for the Port of Redwood City. These samples were taken

prior to maintenance dredging, which occurred in March and April of 1977. These samples indicate that the material was considered "unpolluted," when compared to EPA's criteria for disposal of dredged material on land sites (refer to Appendix B) (5).

The return flow from this site would be monitored according to EPA's criteria, so that the maximum discharge of settleable solids would be 1.0 ml./hour or less, if required by State or local agencies (5). Additional sediment analyses may be required prior to the next maintenance dredging. The dredged material must be "unpolluted" when compared to EPA's criteria, for the material to be influenced by tidal action, as it is in a marsh. Tidal flow could transport any contaminants into the Bay.

The creation of a marsh on this site may have a beneficial impact on local water quality through the release of oxygen and nutrients into the Bay and the uptake of wastes and trace elements.

(f) Air Quality. Operation of dredging and disposal equipment and possibly grading or otherwise preparing and planting the site(s) would have a temporary, minor adverse impact on air quality.

The creation of salt marsh vegetation would have a positive impact on air quality through the conversion of carbon monoxide to carbon dioxide and through production of oxygen. Marshes may serve in other ways to abate poor air quality (1,3). This impact is of a cumulative nature.

(g) Noise. Operation of equipment, mentioned above, would have a short-term, adverse impact on noise levels in the study area. The resulting marsh would be quiet and could serve as a buffer area for noise.

5. Effects on the Biotic Environment.

(a) Vegetation. Disposal of dredged material would remove vegetation, such as pickleweed, brass buttons and grasses, on the interior sides of some of the levees surrounding the salt ponds (6). These alternatives involve the creation of marsh habitat, consisting of pickleweed in the higher elevations and cordgrass in the lower elevations. This would have a very beneficial impact on marsh vegetation. Breaching of dikes located adjacent to the Bay and existing sloughs, as well as creation of sloughs within the site, would provide tidal action within the restored marsh. This tidal activity would provide flushing and would carry nutrients, detritus, as well as plant wastes to the Bay (41). Potential recreational use of the marsh could have an adverse impact on marsh plants and should be planned to control this potential impact.

(b) Shellfish and other Invertebrates. Establishment of a marsh on this site would have a beneficial impact on shellfish and other invertebrates in adjoining sloughs and the Bay. Some invertebrates would probably become established in the restored marsh. Adequate circulation in the marsh would also be important for these potential inhabitants. The detritus originating in a restored marsh would be carried by tidal currents to the mudflats in the South Bay, where it would provide food for shellfish and many other aquatic invertebrates, such as crabs and clams.

(c) Fish. The increase in marsh vegetation associated with this alternative would increase shelter, habitat and the "food" available in the food chain, via shellfish and other invertebrates, for fish in Redwood Creek and the Bay. In general, the productivity of the Bay and even coastal waters is related to the extent and quality of marsh habitat along the Bay shoreline. Sloughs on the site(s) would be designed to retain some water during low tides to provide protected habitat for larval and juvenile fish.

(d) Wildlife. The creation of salt marsh habitat on this site would have a beneficial impact on shorebirds, avocets, black-necked stilts, waterfowl, rodents, rabbits, raptors, and other wildlife which would be expected to use this site. The site would provide food as well as habitat for these wildlife species. The effects of increasing marsh vegetation on the Bay's "food chain" through an increase in shellfish and other invertebrates would also indirectly benefit a variety of birds. One would expect migrating birds in the Pacific Flyway to use the marsh, seasonally.

Some birds may nest in the marsh. Staff from the U.S. Fish and Wildlife Service have suggested creating isolated "islands" of dredged material within the site(s) which would be 2 to 5 feet above MHHW or about 10 to 13 feet above MLLW (41). These higher, isolated areas would support coyote brush, which provides nesting habitat for herons and egrets (41).

Recreational use of a marsh creation project could have an adverse impact on wildlife, including rare and endangered species. Therefore, objectives for recreational use should be formulated with full consideration given to minimize adverse impacts on wildlife in the newly created marsh.

(e) Rare and Endangered Species. The California Clapper rail and salt marsh harvest mouse might extend its range into portions of the created marsh. Other endangered species in the study area may be directly or indirectly (through the food chain) benefited by either of the alternatives. The extent of tidal inundation in a marsh would affect some endangered species, such as the salt marsh harvest mouse, which require a gradual increase in elevations from MLLW to NHHW and higher elevations.

Construction, grading and planting activities associated with the marsh creation alternative on both sites may have an adverse impact on the endangered California least tern. This species nests on the eastern portion of the California Wildlife Management area site and on the outboard dikes surrounding the Leslie Salt Company Evaporator Pond site adjacent to Westpoint Slough. The nesting area on the California Wildlife Management area site is included within the boundaries of the proposed "essential" habitat for this species.

Careful planning of these alternative sites would be required to minimize any possible adverse impacts on the California least tern and its habitat. Construction and planting activities should be scheduled to avoid the nesting season, which occurs between April and August. Appropriate, isolated, nesting habitat should be reconstructed on both of these sites.

Recreational use could have an adverse impact on endangered and rare species which may extend their range into a newly created marsh. Public access and any recreational use would also require careful planning.

(f) Vector Control. Proper design and management of a marsh creation project would be required in order to avoid the creation of mosquito breeding habitats. The California Mosquito and Vector Control Association, in cooperation with the Vector and Waste Management Section, California Department of Health, have developed specific criteria to prevent mosquito problems in marsh restoration projects using dredged material (42). These criteria are based on biological control methods which include topographical surveys in order to determine depressions and circulation systems comprised of sloughs, disking the cracked ground prior to breaching levees and restrictions on water control structures in levees. The specific criteria outlined by these agencies will be followed if these alternatives are considered further.

6. Effects on the Socio-Economic Environment.

(a) Employment. Closing down the Leslie Salt Company's "Redwood City Plant" would probably have some impact on local employment. This proposed shutdown may occur, regardless of the use of the Leslie Salt Company's Evaporator Pond site for disposal of dredged material. Creation of a marsh at either site would require employment of a small number of people to grade, prepare and possibly plant the site.

Disposal of dredged material at an acceptable disposal site would have a beneficial impact on commerce and navigation, and thus on employment, be allowing the maintenance of the Redwood City Harbor Project to be performed.

(b) Commerce/Navigation. Disposal of dredged material via a hydraulic pipeline may create an obstacle for boats and ships traveling in Redwood Creek. This effect could be minimized by careful placement and marking of the pipeline's location.

Disposal of dredged material at an acceptable site would have a beneficial impact on navigation by allowing the continuation of maintenance dredging of the channel. This would presumably have a positive impact on commercial activities dependent on shipping in this area.

(c) Cultural Resources. Implementation of the marsh creation alternatives would adversely affect the operating and abandoned salt evaporator ponds, a cultural resource, by rendering the normal recovery process inoperable. However, these recources are not of sufficient merit to warrant inclusion in the National Register of Historic Places and the resulting resource loss would not be significant. Adequate numbers of operable examples of commercial salt recovery operations of a complexity and condition superior to the subject cases exist as representative samples of this form of economic activity.

In compliance with Section 106 of the National Preservation Act of 1966 (16 USC 470 (f)), the most recent listings of the National Register of Historic Places (Federal Register, February 1977, with monthly supplements) has been consulted and determination has been made that no National Register property, or property determined eligible for inclusion in the National Register, shall be affected by placing dredged material on these sites.

In compliance with Executive Order 11593, "Protection and Enhancement of the Cultural Environment" issued May 13, 1971, the State Office of Historic Preservation has been consulted and determination has been made that no State Historical Points of Interest or State Historical Landmarks will be affected, either adversely or beneficially, by these alternatives. Prior to designation of a final alternative, a cultural resource reconnaissance will be performed.

(d) Existing Land Use. The continuation of commerce and navigation at the Redwood City Harbor Project would have a significant impact on existing land use in the study area, which is closely tied to shipping and maritime activities. The discontinuation of maintenance dredging would probably result in relocation of the Port facilities, including tenants, and a change in land use for the immediate area.

Creation of a marsh on the California Wildlife Management Area site would not result in a change in land use on the site. Creation of a marsh on the Leslie Salt Company's evaporator pond site would result in a change in land use on this site, which is presently used for salt production, by removal of these lands from the Williamson Act. For this alternative the existing land use would be replaced by a marsh, which would have significant wildlife and recreational use.

(e) Farmland/Soils. Creation of a marsh on these sites would not have an impact on prime farmland. Creation of a marsh on the Leslie Salt Company's evaporator pond site would remove the land from salt production and hence, from the Williamson Act.

(f) Community Growth. Creation of a marsh on the Leslie Salt Company's Evaporator Pond site would restrict the potential for growth in the study area and would provide a buffer between development on the uplands and the Bay. Creation of a marsh on the California Wildlife Management Area site would not affect growth, since it has already been designated as a Wildlife Management Area.

(g) Private Property/Property Values. A change in land use as a result of discontinuation of maritime activities, would result in a change in property values. Thus, continuation of existing land use would have a significant impact on private property and property values.

Implementation of this alternative on the Leslie Salt Company's Evaporator Pond site would have an impact on the property owners, the Leslie Salt Company. If the land remained in private ownership, the Leslie Salt Company would be losing the "potential" to fill and develop the ponds. The ponds could be purchased by the Port of Redwood City or by some other "public" entity. Creation of a marsh on the California Wildlife Management Area site would not affect private property or property values.

(5) Tax Revenue/Local Government Finance. The Port of Redwood City presently contributes funds to the City of Redwood City through operation of maritime facilities. The continuation of the Port of Redwood City would have a significant impact on local government finance.

The purchase of the Leslie Salt Company's Evaporator Pond site or portions of it by the Port of Redwood City would remove the property from the tax rolls and thus would decrease the revenues collected by Redwood City and San Mateo County. The removal of this site from the Williamson Act would affect tax revenues collected by the city and county governments. The California Wildlife Management Area site would not require any transfer of private property and therefore would not have an impact on tax revenue or local government finance.

(i) Recreational Opportunities. Creation of marsh habitat on the site(s) would benefit wildlife and endangered species and thus increase recreational opportunities for naturalists and bird-watchers. These alternatives would indirectly benefit fishermen and hunters through the contributions of the marsh to the food chain and thereby its beneficial impact on birds and fish. Recreational opportunities, including public access to the marsh, would require planning to minimize potential adverse impacts on vegetation and wildlife.

(j) Aesthetic/Visual Values. Restoration of marsh habitat would change the visual appearance of the site(s). The site(s) would not be aesthetically pleasing prior to establishment of marsh vegetation, but its aesthetic value would increase following marsh establishment. The area would remain in "open space" and would not interrupt the view of the Bay from other upland areas.

# SECTION 4

# PRELIMINARY EVALUATION

## A. DISPLAY OF IMPACTS

The relative magnitude of the impacts associated with each alternative is shown in Table 6. The items which require review under Section 122 of the River and Harbor Act of 1970 have been addressed in the analysis of impacts. The "no action" alternative, or future condition without the project, is used as a basis for determining the impacts of the alternatives.

TABLE 6

DISPLAY OF IMPACTS

| | No Action | South Bay Disposal Site | Hunter's Point Disposal Site | Alcatraz Disposal Site | Bair Island - Port of Redwood City Site | Bair Island - Cedra Properties Site | Leslie Salt Company's Wash Pond & Salt Stack Site | Leslie Salt Company's Evaporator Pond Site | Ideal Basic Industries Site | Marsh Creation Alternatives: Leslie Salt Company's Evaporator Pond Site | California Wildlife Management Area Site |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Topography | 0 | 0 | 0 | 0 | -2 | -2 | -1 | -1 | -1 | +2 | +2 |
| **Geologic Hazards** | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| Water Circulation | 0 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | -1 | +1 | +1 |
| Sedimentation | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | UK | UK |
| Water Quality | 0 | -1 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | +1 | +1 |
| Air Quality | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | +1 | +1 |
| Noise | 0 | 0 | 0 | 0 | -1 | -1 | 0 | -1 | -1 | 0 | 0 |
| Vegetation | 0 | 0 | 0 | 0 | -2 | -2 | 0 | -1 | -1 | +2 | +2 |
| Shellfish and Other Invertebrates | 0 | -1 | -1 | -1 | -2 | -1 | 0 | 0 | 0 | +2 | +2 |
| Fish | 0 | -1 | -1 | 0 | -2 | -1 | 0 | 0 | 0 | +2 | +2 |
| Wildlife | 0 | 0 | 0 | 0 | -2 | -2 | 0 | -1 | -1 | +2 | +2 |
| Rare and Endangered Species | 0 | 0 | 0 | 0 | -2 | -2 | 0 | -1 | -1 | +1 | +1 |
| Employment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commerce/Navigation | 0 | +1 | +1 | +1 | +1 | +1 | +1 | +1 | +1 | +1 | +1 |
| Cultural Resources | 0 | 0 | 0 | 0 | UK | UK | UK | UK | UK | UK | UK |
| Existing Land Use | 0 | 0 | 0 | 0 | UK | UK | UK | UK | UK | UK | 0 |
| Farmland/Soils | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Community Growth | 0 | 0 | 0 | 0 | +1 | +1 | +1 | +1 | +1 | -1 | 0 |
| Private Property/Property Values | 0 | 0 | 0 | 0 | +1 | +1 | +1 | +1 | +1 | -1 | 0 |
| Tax Revenue/Local Gov't Finance | 0 | 0 | 0 | 0 | 0 | +1 | +1 | +1 | +1 | +1 | 0 |
| Recreational Opportunities | 0 | 0 | 0 | 0 | -1 | -1 | 0 | -1 | 0 | +1 | 0 |
| Aesthetic/Visual Values | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | +1 | +1 |

LEGEND: +2 Highly Positive Effect
+1 Moderately Positive Effect
0 Little or No Effect
-2 Highly Negative Effect
-1 Moderately Negative Effect
UK = Unknown

## B. EVALUATION CRITERIA

Specified evaluation criteria test the value and responsiveness of the different disposal alternatives. Table 7 displays the relationships of the different alternatives to the specified evaluation criteria.

### 1. Acceptability.

Acceptability of an alternative is determined by analyzing its acceptance by the concerned public. An alternative is acceptable if it is, or will likely be, supported by some significant segment of the public. However, every attempt should be made to eliminate, to the extent possible, unacceptability to any significant segment of the public. The acceptability of the alternatives identified in this working paper has not been determined at this time. Comments submitted on this report will help to determine this factor.

### 2. Completeness.

The completeness of an alternative is determined by analyzing whether all necessary investments or other actions necessary to assure full implementation of the alternative have been incorporated. Full implementation would require joint designation of the Hunter's Point and South Bay aquatic disposal sites by the Environmental Protection Agency and the Corps of Engineers, and participation of property owners and provisions of lands for land disposal alternatives.

### 3. Effectiveness.

The effectiveness of an alternative is determined by analyzing its technical performance. Each of the alternatives considered in this report, except the no action alternative and the South Bay aquatic disposal alternative, would be effective for disposal of dredged material. Disposal at the South Bay aquatic site is less effective since it may contribute to shoaling in the San Bruno channel.

### 4. Efficiency.

The efficiency of an alternative is determined by analyzing its cost effectiveness. The costs for some of the alternatives discussed in this report have been computed.

### 5. Certainty.

The certainty of an alternative is determined by analyzing in general terms the likelihood that if the alternative is implemented, the objectives will be attained. All of the alternatives (except no action) are certain in that if they were implemented, the dredged material would be disposed of.

TABLE 7

EVALUATION OF DISPOSAL ALTERNATIVES
IN TERMS OF RESPONSIVENESS

| ALTERNATIVES / EVALUATION CRITERIA | Acceptability | Completeness | Effectiveness | Efficiency | Certainty | Reversibility | Stability | Wetland Preservation |
|---|---|---|---|---|---|---|---|---|
| No Action | UK | NA | NA | NA | NA | NA | NA | NA |
| South Bay Disposal Site | UK | 4 | 4 | UK | 3 | 4 | 3 | 1 |
| Hunter's Point Disposal Site | UK | 4 | 3 | UK | 3 | 4 | 3 | 1 |
| Alcatraz Disposal Site | UK | 3 | 3 | UK | 3 | 4 | 3 | 1 |
| Bair Island - Port of Redwood City Site | UK | 4 | 3 | UK | 3 | 5 | 3 | 5 |
| Bair Island - Cedra Properties Site | UK | 4 | 3 | UK | 3 | 5 | 3 | 5 |
| Leslie Salt Company's Wash Pond & Salt Stack Site | UK | 4 | 3 | UK | 3 | 4 | 3 | 4 |
| Leslie Salt Company's Evaporator Pond Site | UK | 4 | 3 | UK | 3 | 4 | 3 | 4 |
| Ideal Basic Industries Site | UK | 4 | 3 | UK | 3 | 4 | 3 | 5 |
| Marsh Creation Alternatives: | | | | | | | | |
| Leslie Salt Company's Evaporator Pond Site | UK | 4 | 3 | UK | 3 | 3 | 3 | 1 |
| California Wildlife Management Area Site | UK | 4 | 3 | UK | 3 | 3 | 3 | 1 |

LEGEND: 1 = Very Good
2 = Above Average
3 = Average
4 = Below Average
5 = Unsatisfactory

UK = Unknown
NA = Not Applicable

6. Reversibility.

The reversibility of an alternative is determined by analyzing the capability, as public needs and values change or should unusual future circumstances so warrant, of restoring the partially or fully implemented alternative to approximate the without condition. Most of the land disposal alternatives are not really reversible; however, theoretically, the material could be removed. The marsh creation alternatives are more reversible than the land disposal alternatives. In a sense, the aquatic disposal alternatives are reversible, in that they do not change the physical characteristics of the sites, but rather the biological community. Disposal may have some irreversible effects on the composition of the benthic community.

7. Stability. The stability of an alternative is determined by analyzing the variation of alternative future conditions, data and assumptions which can be accommodated by the alternative or minor modifications thereof. Greater stability generally indicates a more desirable alternative plan.

8. Wetland Preservation.

This measures the extent of agreement between the President's Executive Order(Number 11990) on the protection of wetlands and the alternative under consideration. This executive order states that each agency must take action to minimize the destruction, loss or degradation of wetlands, and shall avoid undertaking or providing assistance for "new construction," which includes dredging and filling, unless a practicable alternative does not exist. The two land disposal alternatives on Bair Island and the Ideal Basic Industries' site conflict with this order, since they would involve placing "fill" on wetlands.

C. DISPLAY OF COSTS AND CAPACITIES

The costs and initial capacities for each of the disposal alternatives are given in Table 8. Following placement of dredged material in a land disposal site and consolidation, the dikes could be raised and additional material could be placed on the site(s). This additional capacity of the land disposal sites has not been evaluated for this working paper. Please note that the costs are indicative of the disposal operation and do not include consolidation or grading of the dredged material following land disposal, the purchase or lease of necessary lands by the local sponsor, or planting marsh vegetation.

TABLE 8

DISPLAY OF COSTS AND CAPACITIES

| ALTERNATIVES | CAPACITY (Cubic Yards) | COST PER CUBIC YARD (Dollars) Hopper Dredge | Clamshell & Barge | Hydraulic Pipeline |
|---|---|---|---|---|
| No Action | | | | |
| Aquatic Disposal Sites | | | | |
| South Bay Disposal Site | NA | $ .74 | $ 1.70 | NA 1/ |
| Hunter's Point Disposal Site | NA | 1.82 | 2.26 | NA |
| Alcatraz Disposal Site | NA | 2.52 | 2.62 | NA |
| Land Disposal Sites | | | | |
| Bair Island - Port of Redwood City Site | 370,000 | NA | NA | $ 3.24 |
| Bair Island - Cedra Properties Site | 352,000 | NA | NA | 4.26 |
| Leslie Salt Company's Wash Pond and Salt Stack Site | 326,000 | NA | NA | 3.37 |
| Leslie Salt Company's Evaporator Pond Site | 4,654,000 | NA | NA | 4.40 |
| Ideal Basic Industries Site | 296,000 | NA | NA | 3.38 |
| Marsh Creation Alternatives | | | | |
| Leslie Salt Company's Evaporation Pond Site | 1,844,000 | NA | NA | 4.40 |
| California Wildlife Management Area Site | 1,690,000 | NA | NA | 2.60 |

1/ NA = Not Applicable

## D. RELATIONSHIP WITH LAND USE PLANS

### 1. BCDC Plan.

The Bay Conservation and Development Commission's (BCDC) San Francisco Bay Plan (1969) includes the study area in this report (43). The Cedra Properties and Port of Redwood City land disposal alternative sites on Bair Island, the Leslie Salt Company's wash pond and salt stack site, the Ideal site and the Port's land on the eastern side of Redwood Creek are designated for "Port" use. The Leslie Salt Company's evaporator ponds on the eastern side of Redwood Creek are shown as "salt pond/managed wetland." Greco Island and portions of outer Bair Island are designated as "tidal marsh." In general, BCDC's policy is to minimize fill in marsh or tidal areas around the Bay.

### 2. Special Area Plan.

BCDC and the City of Redwood City are jointly preparing a "Waterfront-Port Special Area Plan" for the study area. A committee with representatives from conservation groups and local, state, and federal agencies has been formed to prepare this plan, which is scheduled to be completed by the end of 1978. This Special Area Plan will eventually be adopted by Redwood City, as an amendment to their General Plan, and by BCDC, as a "Special Area Plan." The relationship of the alternatives discussed in this report to land use plans depends on the completion of the Special Area Plan.

### 3. Baseline EIR on Alternative Development Concepts - Port of Redwood City.

H.K.S., Inc. prepared a Baseline Environmental Impact Report (EIR) on "Alternative Development Concepts for 2,135 Acres in and Adjacent to the City of Redwood City" for the City of Redwood City to provide baseline information for the preparation of the Special Area Plan (6). This EIR presents 5 alternative plans for this area, which range from marsh creation on the Cedra Properties' and Port's lands on Bair Island and the Leslie Salt Company's evaporator ponds to development of the entire area.

These alternatives have been used as a guide in the preparation of land disposal alternatives in this working paper. Thus the alternatives in this working paper range from marsh creation in the Leslie Salt Company's evaporator ponds and California Wildlife Management Area Site, where dredged material would be required to provide proper elevations, to the placement of dredged material on the sites to provide land capable of being developed. The Special Area Plan will determine the future land use in the study area and will probably propose some combination of fill and marsh restoration.

4. State of California Wetland Policy.

This policy recognizes the value of marshlands and other wetlands. Basically, the Resource Agency and its various departments will not authorize or approve projects that fill or otherwise harm or destroy coastal, estuarine, or inland wetlands. Exceptions may be granted if all the following conditions are met: (1) project is water dependent; (2) no feasible, less environmentally damaging alternative is available; (3) the public trust is not adversely affected; and (4) adequate compensation is part of the project.

5. Chief of Engineers Wetland Policy.

This policy declares wetland to be vital areas constituting productive and valuable public resources. Alteration or destruction of wetlands is discouraged as contrary to the public interest. Wetland functions considered important to the public interest are delineated in the July 19, 1977 Federal Register.

Cumulative effects of small changes in wetlands often result in major wetland impairment. Therefore, Federal projects affecting a particular wetland site will be evaluated with respect to the complete and interrelated wetland area.

No construction activity will occur in wetlands delineated as important to the public interest, unless the District Engineer (DE) concludes the benefits of the alteration outweigh the damage to the wetlands and the alteration is necessary to realize the benefits. The DE must demonstrate the need to locate the project in the wetland (water dependent) and must evaluate the availability of feasible alternative sites.

6. Executive Order 11990 on Wetlands.

Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities. This policy states that Federal agencies should avoid to the extent possible the long- and short-term adverse impacts associated with destruction or modification of wetlands. The agency shall also avoid undertaking and providing support for new construction including draining, dredging, channelizing, filling, diking, impounding and related activities, located in wetlands, unless the agency head finds: (1) no practicable alternative and (2) all practical measures have been taken to minimize harm to wetlands. In making this finding, the agency head may take into account economic, environmental and other pertinent factors.

## E. ENVIRONMENTAL STATEMENT

The selection of a land disposal alternative would require the preparation of a supplement to the Final Composite Environmental Statement on Maintenance Dredging (1). If an alternative disposal site requires modifications that are within the Corps' jurisdiction under Section 404 of the Federal Water Pollution Control Act or Section 10 of the Rivers and Harbors Act of 1899, a permit application by the local sponsor would be required. In this case, an Environmental Statement for the permit action would be prepared instead of a Supplement to the Composite Statement.

The selection of either the Hunter's Point or South Bay aquatic disposal alternatives would also require a supplement to the Composite Statement, since these sites were not included in the Composite Statement.

## F. POTENTIAL MITIGATION FOR ADVERSE IMPACTS

Mitigation for the loss of wetlands or salt pond habitat would be required. The alternative sites on Bair Island would require the most extensive mitigation plans. Marsh restoration in a portion of the study area may well be part of a mitigation plan for an alternative that would modify or eliminate marsh vegetation. Likewise, a practicable alternative on the Leslie Salt Company's evaporator pond site may involve filling some of the ponds with dredged material and restoring other ponds to marsh habitat, as mitigation.

The Port of Redwood City has suggested opening up Deepwater Slough to tidal action from Redwood Creek as a mitigation plan for building a levee on the interior side of Deepwater Slough on their property on Bair Island. The plan would involve removing the fill placed at the northern confluence of Deepwater Slough with Redwood Creek (3). The U.S. Fish and Wildlife Service does not feel that the mitigation proposed by the Port is adequate. The U.S. Fish and Wildlife Service proposed an alternative mitigation plan, in connection with the Port's permit application, in their letter to the Corps dated 9 December 1976 (44).

This preliminary mitigation plan would involve placing a dike around the higher, filled portion of the Port's land, and disposing in this area. Once this site is no longer usable for disposal, it would be sculptured and planted for wildlife use and deeded to an appropriate agency for "maintenance in perpetuity" for fish and wildlife. The marsh land surrounding this higher area would be deeded over to the State or Federal government, to become a part of the State of California Wildlife Management Area or San Francisco Bay National Wildlife Refuge. Both ends of Deepwater Slough would be opened in order to receive tidal action from Redwood Creek.

## SECTION 5

## COORDINATION

The views and suggestions of governmental agencies, public and private organizations and interested individuals have been and will be sought and considered. It is hoped that this working paper will establish a firmer and more meaningful coordination, prior to a draft environmental statement, should one be needed, by generating comments from other governmental agencies, conservation groups, and private citizens. All comments will be considered and evaluated during the more detailed further planning and in any draft environmental statement.

Coordination with federal, state, county, city and regional agencies, civic organizations, businesses, port authorities and conservation groups has been conducted during the preparation of the Composite Statement on Maintenance Dredging. The meeting of the "Dredge Advisory Group," held in November 1974, presented the proposed outline of the Working Paper for the Composite Statement. Representatives of various agencies attended this meeting. Comments received on the Working Paper were used to help prepare the Draft Composite Statement. A public meeting was held on 14 October 1975 in order to solicit additional comments on the Draft Composite Statement. Smaller, informal meetings with certain groups were also held.

Informal coordination with the following agencies and other groups has been initiated during the preparation of this working paper: U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, California Department of Fish and Game, Bay Conservation and Development Commission, Port of Redwood City, and the Leslie Salt Company. Representatives of the San Francisco District have attended all meetings of the Advisory Committee to prepare a Waterfront Special Area Plan for the Port of Redwood City environs.

Prior to designation of a final alternative, a cultural resource reconnaissance will be performed. Reports documenting the survey and findings will be coordinated with the appropriate state and federal agencies and will be made available to the public, excluding sensitive or site locational data, upon written request. Should the field examination identify previously undetected resources, the San Francisco District will initiate coordination with the State Office of Historic Preservation and will comply with applicable federal regulations governing cultural resources.

Section 7 of the Endangered Species Act of 1973 requires that the Corps of Engineers consult with the U.S. Fish and Wildlife Service or the National Marine Fisheries Service to ensure that actions proposed by the Corps do not jeopardize the continued existence of endangered or threatened species or their critical habitat. Since disposal of dredged material on land sites identified in this working paper may adversely affect endangered species, formal coordination with the U.S. Fish and Wildlife Service will be initiated by the Corps of Engineers when final alternative sites are identified.

## SECTION 6

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APPENDIX A

THE PORT OF REDWOOD CITY
THE NEED FOR MAINTENANCE DREDGING

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# APPENDIX A

## THE PORT OF REDWOOD CITY

## THE NEED FOR MAINTENANCE DREDGING

### A. INTRODUCTION

A study of the commerce of the Port of Redwood City has been conducted by the Economics Section of the Water Resource and Urban Planning Branch of the Corps of Engineers in 1977. The basic purpose of this study was to verify the need for continued maintenance dredging of the authorized project.

### B. HISTORY OF MAINTENANCE DREDGING

The existing project is described in Section 1 of this report. Until recent years the maintenance dredging was performed every year by hopper dredge. Extensive discussions with personnel of the Construction-Operations Division of the San Francisco District Corps of Engineers indicate that for the period 1970-1977, the dredging cycle was every two years. The program now calls for maintenance dredging every four years. The change in the dredging cycle is due in part to the high cost for mobilization and demobilization of dredging equipment and in part to the difficulty of locating adequate disposal areas for dredged material. The lack of adequate dredge material disposal sites has been one of the main reason for not performing any maintenance dredging since 1971. Information received from the Construction-Operations Division indicates that actual traffic in the waterway was not a consideration in this determination. Since 1970 when the last dredging took place, the channel has silted up considerably; in some locations the depth in the center of the channel is 27 feet MLLW (Mean Lower Low Water) and along the edges it is 24 feet MLLW.

### C. THE PORT

According to the report, San Francisco Bay In-Depth Study, Vessels and Port Facilities Analysis, January 1976, prepared by this District, Redwood City Harbor is considered to be one of the six major ports of the San Francisco Bay system. The others are Oakland, San Francisco, Richmond, Stockton and Sacramento. The port is primarily devoted to the handling of bulk cargoes. The major commodities historically handled have been cement, petroleum, limestone, marine shells, salt, lumber and logs. Recent trends indicate that this composition is changing.

1. Commodity Flows.

In 1969 there were approximately 2,685,000 tons of cargo shipped via Redwood City Harbor. For 1974 the figure had dropped to approximately 447,000 tons, showing a decline in nearly every intervening year. The most recent data indicate a moderate, but not dramatic, improvement, as revealed in Table A-1. An explanation for the decline in shipping of such commodities as marine shells, limestone, salt, and lumber is presented below.

The largest tonnages shipped or received in the Redwood City Harbor have been those items used by the cement industry such as marine shells and limestone and salt. The importer of marine shells and limestone was Ideal Cement Company and when that company closed down its cement manufacturing operations in the South Bay area, its imports ceased as well. The decline in salt exports was due to the fact that Leslie Salt Company was planning to phase out its salt operation in the South Bay area but due to the improved competitive outlook for its product and the difficulty it is having in obtaining reliable long-term output from its Australian operations, it is contemplating the resumption of its salt manufacturing operation. In fact, it is presently surveying the channel to determine if the vessels it plans to use in the Far East trade would be able to traverse the channel to its loading dock, given the present condition of the channel. Lumber imports through the Redwood City Harbor ceased over a period of time due to the gradual increase in barging rates and longshoring cost up to a point where the lumber importer found it to his advantage to bring in his supplies by truck or rail. It is not likely that these imports will be resumed.

2. Future Trends.

From a simple extrapolation of the data presented in Table A-1, it might be concluded that the port is diminishing in importance and will not be needed in the future. A more detailed investigation, however, leads to an opposite conclusion: that is, the port appears to be in a period of transition with new management and plans for future development. Over the past several years, the areas adjacent to the port and the port itself, have become underutilized as some of the longstanding users of the port, such as Leslie Salt Company and until recently, Hubbard Lumber Company and Ideal Basic Industries, Inc., have phased out their operations or are in the process of phasing out their operations at Redwood City Harbor. These activities have not been replaced as yet. However, as cited above, recent information obtained from Leslie Salt indicates that there is every possibility that they will resume their salt manufacturing operations at Redwood City due to difficulties they are experiencing at their foreign operations.

TABLE A-1

COMMERCIAL TONNAGE

Port of Redwood City

| | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|---|---|---|
| Cement | 526,867 | 546,521 | 97,664 | 79,086 | 6,067 | 30,130 | 68,900 |
| Marine Shells | 1,156,976 | 901,350 | 5,500 | 4,668 | 7,200 | - | - |
| Jet Fuel | 30,506 | 3,330 | 15,821 | 25,112 | 24,374 | 37,064 | 62,800 |
| Other Pet. Products | 241,861 | 211,190 | 255,945 | 320,539 | 218,179 | 188,022 | 185,500 |
| Salt | 564,114 | 374,270 | 471,220 | 420,241 | 158,856 | 96,008 | 161,900 |
| Lumber & Logs | 55,170 | 50,500 | 7,024 | - | - | 898 | - |
| Scrap Metal | - | - | - | - | 11,114 | 7,320 | 16,700 |
| Limestone | 85,488 | 83,804 | 48,221 | 92,680 | 18,096 | - | - |
| Sand | 22,694 | 14,900 | 19,750 | 17,117 | 16,000 | 87,455 | 80,000 |
| Other | 1,394 | 1,988 | 3 | - | 8,085 | 238 | |
| TOTAL | 2,685,070 | 2,182,219 | 919,538 | 959,443 | 467,967 | 447,135 | 575,800 |
| Foreign | 1,601,570 | 361,113 | 539,804 | 641,525 | 222,599 | 125,253 | 232,200 |
| Coastwise | 1,414,102 | 692,477 | 176,538 | 92,986 | 27,947 | 35,141 | 75,900 |
| Internal | 669,398 | 1,128,609 | 203,176 | 224,932 | 217,421 | 286,741 | 267,700 |

Another tenant of the Port, Texaco, Inc., is planning to expand its activity at the Port. Texaco, Inc. presently uses four tankers and is planning a fifth tanker in servicing its Redwood City facilities which have fully loaded drafts of 30'-6". These vessels originate both from the Caribbean and the Persian Gulf. The frequency of calls is about one a month. In addition, Texaco utilizes barges to haul in other petroleum products from various locations in the San Francisco Bay area. These barges have an average draft of 10 feet. Texaco presently contemplates increased activity at its Redwood City terminal due to its expanded marketing and distribution service. To accommodate Texaco's anticipated traffic, the Port of Redwood City plans to restructure the Wharf 4 oil dock to provide alternate fuel discharging facilities to accommodate Texaco as well as to rehabilitate and establish bulk liquid storage at the former Shell and Union "76" facilities at the Port. This renovation program is expected to be completed no later than February 1979 with every effort being made to complete the work prior to that date.

Based upon the current and projected needs for Bay Area shipping, together with the port's plans for development, the long range forecast for the port is for growth and expansion. Locations in San Francisco Bay adjacent to a deepwater port are limited and are needed to handle current and increased future Bay Area shipping requirements. There is presented in the next paragraph information on the development programs which indicate that, once past this transition period, the Port will again become an active element in San Francisco Bay Area commerce.

3. The Development Program

The Port of Redwood City has launched a program designed to modernize and expand its operation. The Port completed a $300,000 modification of Wharf 4 to accommodate vessels calling for scrap steel exports in February 1977. The Port also expects to complete further modification and expansion of the wharf to accommodate tankers by February 1979. The cost of this work is estimated to be $750,000. As an indication of future need for certain types of port facilities in the San Francisco Bay Area, reference is made to two reports prepared by the San Francisco District Corps of Engineers entitled: "San Francisco Bay Area In-Depth Study - New Facility Analysis" (June 1976) and "Waterborne Commerce Projections and Commodity Flow Analysis for the San Francisco Bay Region" (September 1976). These reports, drawing upon commodity projections made for the San Francisco Bay Area, concluded that dry bulk cargo moving through Redwood City Harbor would be as follows:

| | (Short Tons per Year) |
|---|---|
| 1980 | 900,000 |
| 2000 | 1,620,000 |
| 2020 | 4,620,000 |

When these tonnages were translated into facilities, 4 berths would be required in 1980 and 2000 and 6 by year 2020. This would be the need when using the medium projections and when using the high projection 4 berths by 1980, 5 by 2000 and 6 by 2020. Breakbulk cargo forecast indicates the need for one berth for the present and future; and liquid bulk cargo would be handled at the general cargo-bulk terminals.

In addition to the studies relating to commodity forecast and facilities, the Port of Redwood City has its own immediate and long-range development plans to renovate and upgrade its Port facilities; they are as follows:

a. Phase 1 of Wharf 4 modifications have been made to accommodate the scrap steel export vessels of Levin Metals Corporation. The cost of the modifications has been placed at $300,000 and was completed on 15 February 1977.

b. Phase 2 of the renovation program is to provide for a 600-foot long new wharf at Wharf 4; it would include provisions for pipelines with hose connections for the unloading of petroleum products. The estimated completion date is towards the end of 1979 and would cost an estimated $4,330,000; the $750,000 referred to above is included in this phase.

c. Phase 3 is composed of two parts. The main part is to replace the existing old Wharf 3; the new Wharf 3 would be 560 feet long. The second part would extend 240 feet from the south end of the new wharf built as Phase 1. When Phase 3 is completed, the Port would have a 1,400-foot long straight berth frontage. Depending on ship size and cargo handling requirements, this frontage could provide two or three berths. Thus, the total planned expenditure for renovation and expansion of the present facilities is about $10,330,000 - Phase 1 $300,000; Phase 2 $4,330,000; and Phase 3 $5,700,000. In addition, Levin Metals Corp. operating at the Port of Redwood City under a 10/10 year lease (a 10-year lease with an option to renew for another 10 years) has completed installation in December 1976 of an automatic metal shredder including a mechanical conveyor shiploader with capacity to deliver 500 tons of shredded scrap metal per hour. Value of this investment alone has been placed at $2 million.

Markovitz and Fox, another scrap steel exporting firm, has been a tenant of the Port since 1973. The firm is operating under a 10/5 year lease (a 10-year lease with an option to renew for another 5 years). Texaco, Inc. has 25 years on its leasing arrangements with the Port. Based upon these development programs, it is expected that the Port will again become an active element in the waterborne commerce of the San Francisco Bay Area.

In addition to these immediate renovations, the port had plans to acquire adjacent lands, particularly some of the Leslie Salt Company properties. These plans may have to be revised should Leslie resume its salt manufacturing operation in the Redwood City area. Ideal Cement Company lands are planned to be part of new port development. The precise use of these lands has not been specified in detail at this time. As to the method of acquisition of some of the Leslie land, the port may purchase these lands with a lease-back arrangement on a part of the land; in regard to the Ideal Cement land, the arrangement may be similar to that of the Leslie land or Ideal may decide to manage the operations itself.

Other aspects of the plan include office and warehouse space, a restaurant and other commercial uses, and a ferry terminal for service to San Francisco. While each element has been determined to be (by a port consultant) economically feasible, the extent and timing of the development plans have not yet been finalized.

## D. THE DEEPWATER PORT STUDY

The San Francisco District, U.S. Army Corps of Engineers, has studied the long-range requirements and capacities of the San Francisco Bay port system. The resulting report, The San Francisco Bay Area In-Depth Study[1/], conclude that there is an immediate as well as long-term need for the Port of Redwood City. The immediate need is based upon the near term projections (1980) of breakbulk cargo and the longer term projections for years 2000 and 2020.

Currently, there are four dry bulk terminals, one liquid bulk terminal and one breakbulk terminal at the Port of Redwood City. According to the In-Depth Study, there will be increased requirements for all types of berthing terminals over the study period (1980-2020) based on the "most likely future" (medium projection). In fact the study indicates that there will be an "unmet demand"[2/] for dry bulk cargo berthing for 1980. For the Redwood City Port Area the study projects increased cargoes and by 2020 that two additional berths should be developed.

Sensitivity. The waterborne commerce projections made for the San Francisco Bay Area In-Depth Study also made a "high" and "low" projections of future commodity flows. The low projection indicated no need for additional facilities; the high indicates an increased berthing requirement by 2000.

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1/ New Facilities Analysis and Public Brochure.
2/ Ibid, p. 34.

## E. ECONOMIC CONSIDERATIONS

In order to provide a basis for the economic evaluation of the dredging program for Redwood City Harbor, a benefit-cost ratio for bi-annual dredging was developed. In deriving this ratio, however, allowance was made for the dredging not accomplished in 1971, 1973 and 1975. The costs were derived from recently prepared estimates by the Design Branch of the District for the specific maintenance dredging of Redwood City. The cost data are reflective of a dredge material disposal area of 180 acres located in the vicinity of West Point Slough. With regard to the benefits, some benefits were based on a savings of additional transportation cost associated with using the dredged waterway, e.g., in the case of Markovitz and Fox, scrap steel exporters and tenants at the Port of Redwood City. This method was used where there was a clearly defined alternative associated with a defined operation. In the evaluation of other benefits, sometimes involving the same commodity, as in the case of Levin Metals Corporation, another scrap steel exporter and tenant of the Port, it was necessary to use estimates based on a reasonable rate of return for located on-site investments. The benefit derived in this manner would be at least equal to the minimum losses that the firm would sustain in the absence of waterway. In another instance the incremental value of port area land with and without a navigable channel versus standard industrial-commercial land was used.

1. Costs. Based upon extended discussions on 4 to 5 occasions with personnel in the Construction-Operations Division of the San Francisco District and information received from them, the maintenance dredging cycle of the Redwood City Harbor subsequent to 1970 was considered to be a 2-year cycle. The 2-year cycle was based upon considerations such as the quantity that would have to be dredged should it be on an annual basis versus the quantities for a 2-year basis and the high mobilization and demobilization cost. In late 1977 this was revised to a 4-year cycle; this is taken into account at the end of this paragraph when annual costs were determined. The last maintenance dredging of the channel occurred during March-April 1977 when 244,000 cubic yards were removed by hopper dredge. There was dredging planned for 1971 by hopper dredge, but due to a protest over the dredging contract, the dredging was not performed. Although channel surveys conducted each year subsequent to 1970 indicated that some dredging should be accomplished in order to maintain the authorized channel depths, no maintenance dredging was performed due to the lack of adequate disposal sites for the dredged material. The information furnished by Construction-Operations Division indicated some dredging would have been conducted in 1971, 1973 and 1975 had a disposal site been available and that the present cost of dredging the channel, currently estimated at $1,010,000 (which amount includes E&D and S&A) includes cost which would have been incurred had the previous scheduled dredgings taken place; so that the missed dredging costs

are taken into account, a 7-year dredge cycle is used; thus, the annual costs are $73,500. An alternative method of determining the annual cost is to deduct 75 percent of present estimated cost as 3 cycles out of 4 were not accomplished; i.e., 1971, 1973, 1975, and to use a 2-year cycle (on the 1977 cycle) on the balance of $252,500; on this basis, the annual cost is $73,500. While the current interest rate is 6-5/8 percent, the 1/4 percent change would not have a significant effect on the benefit-to-cost ratio.

2. Benefits. The benefits have been calculated on a commodity-by-commodity basis. In some cases the names of the firms are cited to indicate that a particular method was used to derive benefits for that operation. In all cases, however, it is necessary for the reviewer to read further in order to follow the analysis used to discover who and what is involved.

a. Scrap Steel Exports. Two operations involving the export of scrap steel have recently commenced utilizing Redwood City Harbor - Levin Metals, and Markovitz and Fox.

Firm 1: Markovitz and Fox commenced operating out of the Port of Redwood City in mid-1973. They have a 10-year lease with an option to renew for 5 additional years. During 1974 and 1975 the export operation was restricted by a quota system based upon the 1973 level of operations (which for this concern was only one-half year). Presently, the level of export activity is between 15,000-20,000 tons a year. In 1976, the firm exported 16,095 tons. The firm expects to be exporting between 40,000-50,000 tons in a year or two. The principal markets for the firm are Japan, Taiwan and South Korea. If the shipments are relatively small, LASH barges are utilized for the initial loading; if shipments are large, vessels with drafts of 28 to 30 feet would be utilized. Based on their projected annual increase of exports, the firm expects to export about 100,000 tons by 1980 with export activity fairly constant thereafter.

The firm does not own the vessels in which it exports. During the early period 1973-1975 when the firm began its export business, given the quantities that it had to export, it utilized LASH vessels. While these vessels draw as much as 36 feet when loaded, their method of operation had been to have the vessel dock at Pier 96 at the Port of San Francisco and to send the barges to the Port of Redwood City for loading; these barges generally draw about 8 feet. The firm charters vessels (in addition to LASH) on an occasional basis to meet its needs. As the quantities increase over time, the exporters indicate that they anticipate the use of 15,000-17,000 dwt vessels. Vessels in this category would draw on the order of 28 to 30 feet. For present conditions and quantities, if the channel in Redwood City Harbor were to silt up in the absence of a maintenance dredging program, the exporter would be forced to ship via Oakland or Richmond Harbor. Information on trucking

bull poop - invalid methodology *

cost from the exporters indicates that this would add $4/per ton for trucking to either of these ports. Based upon the current operational rate of 20,000 tons, the annual benefit would be $80,000. While it may be possible that the firm could give up and leave, there would still be a loss incurred in that course of action and the benefits derived by use of additional transportation cost can serve as a proxy for those losses in the short term.

Firm 2: Levin Metals Corporation, an exporter of metal scrap, has just completed a substantial investment program at Redwood City Harbor on the order of $2 million. They have recently installed a metal shredder and have constructed a conveyor and shiploader, which was finished in September 1976. In 1976 about 30,000 tons of shredded scrap steel was exported. Within a 12-month period they plan to ship 150,000 short tons. This tonnage is expected to increase to 300,000. It is assumed that these shipments would be on the largest vessel that the authorized channel can accommodate.

As an indication of this, Sequoia Navigation, a subsidiary of Levin Metals Corporation, presently operates two of its own vessels out of Redwood City Harbor. The Silver Pagoda and the recently acquired Golden State, each at 28,000 deadweight tons, when fully loaded have a draft of 36 feet. The firm is currently contemplating the purchase of a third vessel in anticipation of prospective scrap steel exports. In addition to presently owning two vessels, the firm operates an additional vessel on long-term charter, with the same operating and cargo carrying characteristics.

The evaluation for economic justification can be accomplished by using transportation cost savings or the return on investment concept. The transportation cost savings would yield substantially higher benefits, as the alternative or additional transportation costs generally exceed the return on investment. In addition, there is uncertainty as to what channel depths should be used in the analysis; also, there is no precise without project depth. In view of these constraints, the calculation for benefit evaluation purposes was derived from the return on investment concept. Levin has spent approximately $2 million to establish its scrap metal export operation. Based on a 15-year life for this investment, and using a discount rate of 6-5/8 percent as a rate of return, the average annual benefit would be $214,000 ($2,000,000 x .10721).

Due to present depths in certain reaches of the channel where the vessels load and through which they must traverse when carrying scrap metal from this operation, the vessels carrying scrap metal are not able to fully load and must proceed to Richmond to top off prior to departure for the Far East. While no analysis has been made of this additional trip, it has the net effect of increasing Levin's operating cost.



* [illegible] Redwood City's loss would be someone else's gain, not a regional loss. Scrap metal not tied to Redwood City

Another effect of having a channel not adequately maintained or with an inadequate depth in this harbor is that the operation is constrained to the export of shredded steel scrap. The solid heavy melt steel and iron scrap available in localities close to Redwood City Harbor is transported to the facility at Richmond for export. There are indications that if the channel at Redwood City were deeper than what it is presently, such scrap material could be exported out of Redwood City Harbor, thereby resulting in a savings of those associated land transport costs. This aspect was not evaluated due to lack of data.

b. Cement. Kaiser Corporation is currently shipping approximately 80,000 tons of cement on larges barges (16'-18' draft) for delivery to Washington and Oregon to help meet their 250,000 ton per year commitment to that area. The loading facilities at Kaiser are maintained at 26 feet MLLW. The remaining 170,000 tons are supplied through an exchange agreement with another cement producer, Lonestar Corporation. By 1980, Lonestar will produce their own cement in the Northwest and the exchange agreement will be terminated. At that time, Kaiser will ship all 250,000 tons waterborne via Redwood City Harbor. If the Redwood City Harbor project were not maintained, Kaiser would be forced to ship via the next nearest port, which in this case would be the Port of San Francisco - 48 miles versus 53 to the Port of Oakland. The current transport involves truck shipment from the plant 22 miles from Redwood City at a cost of $1.90 per ton, where it is stored for shipment by barge to the Northwest. The cost of trucking to San Francisco is $4.10 per ton or a $2.20 more than trucking to Redwood City.

COST COMPARISON

| | Present Cost | Alternative Cost |
|---|---|---|
| Barge | $ 9.00 | $ 9.00 |
| Truck | 1.90 | 4.10 |
| Rehandling | .71 | .71 |
| | $11.61 | $13.81 |
| Differential | | $ 2.20 |

The cost differential - $2.20 - represents the benefits per ton. The current per year total benefit is $2.20 x 80,000 tons = $176,000. An alternative method of measuring the benefit could be based on relocation of the cement export facility at the port. The capital investment consists of storage silos and supporting facilities; total replacement value would be approximately $1,000,000. Using a 15-year life (6-3/8 percent Federal Discount Rate), the capital recovery factor is .10550. The annual cost would be .10550 x 1,000,000 = $106,000. Due to the location, there would be an added truck cost of $1,00 per ton - 80,000 x 1.00 = $80,000. Thus, the total addes cost is $186,000. On the basis of least costs, the claimable benefit would be $176,000.

c. Salt. The Leslie Salt operation at Redwood City, until about a year ago, was considered to be marginal and likely to be closed down. This event was to occur after the current salt harvests were completed and the output shipped - approximately 3 to 5 years. Leslie has on hand about 400,000 to 500,000 tons; the future harvests were estimated to be 300,000 tons so that the total to be shipped ranged between 700,000 to 800,000 tons - at a rate of 175,000 tons a year. Part of the decision to close down the Redwood City operation was based upon the fact that the company thought it could meet its Far East commitments from its operations in Australia. Due to the difficulty that it has been experiencing in that operation, it is planning to resume its Redwood City operation as a means of satisfying its Far East markets as well as its markets in the Pacific Northwest. Towards the end of servicing the Far East markets, Leslie is planning to use in the very near future a 20,000-25,000 DWT bulk carrier with a draft of 30 feet when fully loaded. Markets in the Pacific Northwest are serviced by barges which, when fully loaded with 8,500 tons of salt, have a draft of 20 feet. Leslie has indicated that shipments to the Far East would be at least 25,000 tons at the resumption of this trade and could go as high as 200,000 tons a year. If Redwood City Harbor were not available to them for export to the Far East or to the Pacific Northwest, then the company would close its Redwood City salt production and ship out of its Newark facility. Leslie cost data indicate that it would cost $6.00 to haul a ton of salt to the Port of Oakland and that it would incur another $6.00 handling charge. At this point, Leslie would not be competitive and would abandon those markets. The value of a ton of salt is about $6.00 a ton. The Redwood Harbor salt production operation is capable of producing about 150,000-200,000 tons per year. If the company were to close this operation, it would lose its profit on this production, estimated for this analysis to be at least equal to the current interest rate of high grade industrial bonds of about 8-1/4 percent - or $87,000 annually (175,000 [average between 150,000-200,000] x $6 x .0825). Should Leslie have to abandon its Redwood City salt production facility, there would still be a considerable cost associated with the abandonment of Redwood City Harbor.

Bay Area port lands are valued at approximately $75,000 per acre. At a minimum, Leslie's holdings include 100 acres that could be converted to port use. Ordinary commercial-industrial lands are valued at $50,000-$60,000 per acre. Thus, the land values would therefore be lowered by $15,000-$25,000 per acre if the harbor were not maintained. At the Federal Discount Rate of 6-3/8 percent and a 50-year life, the "return" would be .06679 x $20,000 x 100 or $98,000 per year allowing for a 5-year deferral. There would be additional costs also at that time of having to shut down the plant. However, for the near term, the return on lost production is used to measure the impact and is used to reflect the annual benefit for this operation of maintenance dredging.

d. Sand. The Granite Rock Company - a concrete, sand and gravel operation - is located on Redwood Creek slightly above the end of that part of the authorized project, which has an authorized depth of 5 feet. Granite Rock has a current market for over 100,000 tons annually, but due to a limitation on available sand supplies from the Sacramento-San Joaquin Delta, receipts have been limited to an annual rate of 80,000 tons. Discussions with representatives of the company indicate that future supplies are most likely to come from locations within San Francisco Bay such as Presidio Shoals, and the same quantities are expected. Sand is transported to Granite facility barges which, when fully loaded, draw about 12 feet of water. Tides are utilized in bringing barges up to its unloading docks.

While the depths in the 30-foot MLLW present no problem to Granite, the depths in the 5-foot MLLW portion, based upon 1973 survey data, appear to be at authorized depth. The company uses the tides to bring in the loaded barges and they have noted that when the tide is out the barges sit on the bottom of the channel. Granite personnel have indicated that, due to the high cost of rehandling sand and the market value of sand, should the sand have to be rehandled, their product would not be competitive. However, since the presently planned dredging does not include this portion of the authorized channel, no benefits were evaluated for this portion of the channel.

e. Ideal Basic Industries. Until 1971, Ideal produced cement at a factory adjacent to the port, both receiving raw materials and shipping the final product from the port. They have since relocated in Colorado to avoid problems with air pollution in the Bay Area. Ideal is very actively pursuing arrangements to lease or sell their holdings to potential users, with the pricing based upon the deepwater potential of their land. Based on a differential value of $20,000 per acre for port land versus ordinary commercial-industrial land for Ideal's land holding of 145 acres, the total impact would be ($20,000 x 145) $2,900,000. Using the Federal Discount rate of 6-3/8 percent, the annual return is $194,000. To allow for a certain period of time for this to happen, the value could be defined for a period of 5 years; on this basis, the benefit is $142,000.

f. Texaco, Inc. Texaco operates a fuel storage and distribution terminal on property near the Port of Redwood City. The lease is for 25 years. The storage facilities are located on a nine-acre parcel, with a capacity of 367,000 barrels. Texaco, on an average, delivers 1.6 million barrels of jet fuel and gasoline to the facility annually.

There are five Texaco tankers in the T-2 category (16,000 dwt) which transport these cargoes to the terminal. These vessels draw 30'6" when fully loaded. In addition to the tanker fleet servicing the terminal, there is a barge fleet which delivers fuel primarily from its Richmond terminal.

Should conditions in the channel become such that tankers are unable to call, then deliveries would have to be made by barge. This would mean that tanker deliveries would have to be made to the Texaco storage facilities at Richmond and transshipped by barge to Redwood City.

It is reported that the present depths (27 feet MLLW between Buoys 10 and 16) of the channel at Redwood City restrict the use of tankers calling at the Texaco facility. Thus in the short term - next 4 to 5 years - should the depths of the channel become such that no tankers could call at the port, then Texaco would have to deliver all of its petroleum products to its Richmond storage facility and then transship by barge to its Redwood City facility. It is estimated that about one-half to three-quarters of its estimated annual volume of 1,600,000 barrels would have to be handled in this manner.

Based upon information obtained from barging companies operating in this trade, the cost of moving a barrel of petroleum products from Richmond to the Port of Redwood City is 11-1/4 cents per barrel. On this basis, using the lower volume estimate, the additional annual cost or benefit would be $90,000 (800,000 x .1125).

g. Recreational Boating. In addition to commercial traffic, there are three marinas located along the Redwood City Harbor project - Redwood City Municipal Marina (200 berths), Redwood Docktown (208 berths), and Pete's Marina (135 berths). All of the total of 543 berthing spaces are currently filled. Two of the marinas have immediate plans for expansion and the third marina plans to expand its berthing facilities in three to four years.

h. Project Impact. The authorized project extends up to mile 3, and between mile 3 and mile 2 the authorized depth is 5 feet mean lower low water (MLLW). Please see map attached. The last maintenance dredging was performed during FY 1960. The center channel appears to be at the authorized depth, but along the length of this channel, on both edges, siltation has occurred so the depth at the edges is about 3 feet. It should be noted that this portion of the authorized channel is not included in presently proposed maintenance dredging. While no benefits are taken for this part of the present maintenance program, the following illustrates the magnitude of the effect, should the channel condition becomes such that the two affected marinas are constrained to certain tidal conditions.

i. Benefits. The benefits for recreational boating, derived in accordance with guidelines set forth in EM 1120-2-113, the Small Boat Formula, are claimed for existing boats for the two marinas located along the Slough.



* map follows p. A-9

Even if the channel is not maintained, it is assumed that the marinas will still have the same boats; however, the unit recreational value will be diminished. This is reflected through the Small Boat Formula lowering the percent return within the permissible range of 6 - 9 percent. On this basis the benefits amount to $43,300. See Table 2 for details on these computations.

j. Summary of Benefits. A summary of the benefits is presented below:

TOTAL ANNUAL BENEFITS

| | |
|---|---|
| Scrap Metal #1 | $ 80,000 |
| Scrap Metal #2 | 165,000 |
| Salt | 87,000 |
| Texaco | 90,000 |
| Total | $422,000 |

3. Benefit-Cost Ratio. The B/C ratio based on a cost of $73,500 per year and an annual benefit of $422,000 = 5.74:1.0.

F. ADDITIONAL CONSIDERATIONS

The benefits are derived from tonnage data produced at a time when the port is under utilized and appears to be developing in many directions.

Further, the economic justification for continued maintenance differs considerably from the economic justification for development or expansion of navigational facilities. Present commercial users would be forced to react. In any case, the users have already located near the waterway and the costs of not dredging are more intensely felt.

G. RECOMMENDATION

Based on the information generated within this report*, there appears to be sufficient economic justification to recommend that the maintenance program be continued.

* what about the regional perspective?

TABLE 2

SMALL CRAFT RECREATIONAL BENEFITS
FOR MAINTENANCE OF REDWOOD HARBOR

| Type of Boat | Average 1/ Depreciated Value (1) | Range of Benefits (% of A.D.V.) | Return (%) With | Return (%) Without 2/ | Return (%) Net (2) | No. of Boats Marina #1 (3) | No. of Boats Marina #2 (4) | Benefits (1)x(2)x[(3)+(4)] |
|---|---|---|---|---|---|---|---|---|
| Sail (20-29') | 4,000 | .06-.09 | .08 | .07 | .01 | 86 | 27 | 4,500 |
| Sail (29'+) | 15,000 | .06-.09 | .08 | .07 | .01 | 40 | 44 | 12,600 |
| Power (<29') | 5,200 | .06-.09 | .08 | .07 | .01 | 37 | 15 | 2,750 |
| Power (29'+) | 25,000 | .06-.09 | .08 | .07 | .01 | 45 | 49 | 23,500 |
| | | | TOTAL | | | 208 | 135 | 43,300 |

1/ Based on value of berthed boats, San Mateo County, updated to 1976 prices. North Coast Study (1971).

2/ High tide use only.

# APPENDIX B

## SEDIMENT SAMPLES - REDWOOD CITY HARBOR AND DEEPWATER SLOUGH

Two sets of samples were taken by the Port of Redwood City in the Redwood City Harbor Project in February and March of 1977, prior to disposal of dredged material at the Alcatraz aquatic site. The location of the sampling stations is shown on Plate B-1. Sediment samples were also taken in Deepwater Slough, as shown on Plate B-1, prior to preparation of the Corps' Draft Environmental Statement on the Port's permit application on Bair Island, prepared in 1975 (3). These samples are also included.

TABLE B-1

SEDIMENT ANALYSIS*
REDWOOD CITY HARBOR PROJECT

| SAMPLE | LEAD mg/kg dry | ZINC mg/kg dry | CADMIUM mg/kg dry | MERCURY mg/kg dry | OIL & GREASE mg/kg dry |
|---|---|---|---|---|---|
| A1 | 51 | 160 | 1.5 | .22 | 370 |
| B11 | 44 | 150 | 1.8 | .25 | 680 |
| B2-1 | 42 | 150 | 1.8 | .25 | 300 |
| C1-1 | 55 | 160 | 1.6 | .28 | 160 |
| C2-1 | 49 | 160 | 1.7 | .30 | 470 |
| C3-1 | 42 | 150 | 1.3 | .30 | 240 |
| D1-1 | 48 | 160 | 1.6 | .29 | 510 |
| D2-1 | 46 | 160 | 1.2 | .18 | 1100 |
| E1-1 | 42 | 150 | 1.2 | .24 | 1100 |
| E2-1 | 51 | 150 | 1.3 | .32 | 400 |
| F1-1 | 47 | 160 | 1.3 | .32 | 550 |
| F2-1 | 47 | 160 | 1.4 | .33 | 740 |
| G1-1 | 56 | 160 | 1.4 | .32 | 920 |
| G2-1 | 49 | 160 | 1.4 | .19 | 1200 |
| H1-1 | 52 | 170 | 1.5 | .44 | 1100 |
| H2-1 | 48 | 180 | 1.4 | .26 | 700 |
| I1 | 55 | 180 | 1.2 | .34 | 500 |

*Analysis of core samples received 2/19/77 by Rudd Laboratories for Port of Redwood City.


LEGEND

- A Core sample – Redwood City Harbor Project
- 2 Core sample – Deepwater Slough

1000 0 2000 4000 6000 8000

SCALE IN FEET

SOURCES: Port of Redwood City and Corps of Engineers (1975).

ENVIRONMENTAL STATEMENT

SAN MATEO COUNTY CALIFORNIA

LOCATION OF CORE SAMPLES
REDWOOD CITY HARBOR
AND DEEPWATER SLOUGH

U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
DRAWN: FILE NO.
TRACED: TO ACCOMPANY REPORT
CHECKED: DATED APRIL 1978

PLATE B – 1

TABLE B-2

SEDIMENT ANALYSIS*
REDWOOD CITY HARBOR PROJECT

| SAMPLE | LEAD mg/kg dry | ZINC mg/kg dry | CADMIUM mg/kg dry | MERCURY mg/kg dry | OIL & GREASE mg/kg dry |
|---|---|---|---|---|---|
| L 30-60 | 47 | 140 | 1.3 | .92 | 350 |
| L 60-90 | 46 | 140 | 1.4 | .28 | 570 |
| C 30-60 | 55 | 150 | 1.5 | .37 | 1100 |
| D 30-60 | 68 | 190 | 1.7 | .40 | 990 |
| E 30-60 | 54 | 160 | 1.3 | .39 | 790 |
| F 30-60 | 55 | 160 | 1.3 | .47 | 480 |
| G 30-60 | 60 | 160 | 1.4 | .51 | 1300 |
| H 30-60 | 62 | 170 | 1.5 | .48 | 1100 |

* Analysis of core samples received 3/1/77 by Rudd Laboratories for Port of Redwood City.

TABLE B-3

DEEPWATER SLOUGH BORING ANALYSIS

| Pollutant (ppm) | Unpolluted Dredged Material Maximum Material Concentration* (ppm) | Boring 1 | | | Boring 2 | | |
|---|---|---|---|---|---|---|---|
| | | 0-6" | 6"-3' | 3' 6' | 0 6" | 6"-3' | 3' 6' |
| Mercury | 1.2 | 0.32 | 0.31 | 0.55 | 0.30 | 0.32 | 0.51 |
| Cadmium | 2.3 | 0.63 | 0.96 | 1.00 | 1.20 | 1.00 | 1.40 |
| Lead | 75 | 22 | 29 | 44 | 30 | 31 | 40 |
| Zinc | 190 | 92 | 110 | 110 | 110 | 92 | 120 |
| Oil & Grease | 1,900 | 354 | 468 | 604 | 488 | 362 | 872 |

* EPA (5)

APPENDIX C

LISTING OF INVERTEBRATES (SHELLFISH) AND
FISH SPECIES IN REDWOOD CITY HARBOR ENVIRONS

The following list was compiled from the California Department of Fish and Game, 1968(9), personal communication with Staff of same (10), and U.S. Fish and Wildlife Service, 1975/1976(35).

1. INVERTEBRATES

| Common Name | Scientific Name |
|---|---|
| soft shell clam | Mya arenaria |
| Japanese littleneck clam | Tapes semidecussata |
| gaper clams | Tresus nuttalli |
| native oyster | Ostrea lurida |
| ribbed horsemussel | Modiolus demissa |
| dungeness crab | Cancer magister |
| mud or bentnose clam | Macoma nasuta |
| white sand clam | Macoma secta |
| Bay shrimp | Crangon spp. |
| mud snail | Nassarius spp. |
| hermit crab | Pagurus spp. |
| mud crab | - |

2. FISH

| Common Name | Scientific Name |
|---|---|
| shiner perch | Cymatogaster aggregata |
| staghorn sculpin | Leptocottus armatus |
| topsmelt | Atherinops affinis |
| northern anchovy | Engraulis mordax |
| English sole | Parophrys vetulus |
| Pacific herring | Clupeah arengus |
| bat ray | Myliobatis californica |
| white surfperch | Phanerodon furcatus |
| diamond turbot | Hypsopsetta guttulata |
| California halibut | Paralichthys californicus |
| starry flounder | Platichthys stellatus |
| three spine stickleback | Gasterosteus aculeatus |
| cheekspot goby | Ilypnus gilberti |
| barred surfperch | Amphistichus argenteus |
| Bay pipefish | Syngnathus griseolineatus |

| Common Name | Scientific Name |
|---|---|
| jacksmelt | *Atherinopsis californiensis* |
| surf smelt | *Hypomesus pretiosus* |
| arrow goby | *Clevelandia ios* |
| long jaw mudsucker | *Gillichthys mirabilis* |
| striped bass | *Morone saxatilis* |
| brown smoothhound | *Mustelus henlei* |

# APPENDIX D

## BENTHIC COMMUNITY STUDIES - ALTERNATIVE AQUATIC DISPOSAL SITES

The following information was excerpted directly from the Corps of Engineers' Dredge Disposal Study, August 1975, Appendix D. Biological Community (11). This study was conducted by the Stanford Research Institute (SRI) for the Corps of Engineers. The data is organized by the three alternative aquatic disposal sites: South Bay, Hunter's Point, and Alcatraz.

The Stanford Research Institute (SRI) established two sampling stations at the South Bay aquatic disposal site (SB-A and SB-B) and one station each at the Hunter's Point and Alcatraz aquatic disposal sites.

1. South Bay Stations.

SRI recovered 1,486 noncolonial specimens representing 39 different taxa from sediment samples taken in March 1975 at Station SB-A where 5,000 cubic yards were disposed of during the study. Station SB-B was not disturbed by disposal activities and thus serves as a "control." SRI collected 91 taxa at Station SB-B, including 35 Polychaeta, 21 Arthropoda, 18 Mollusca, and 8 Ectoprocta. The size of the benthic population at SB-B fluctuated quite a bit. In March 1973, each liter of sediment contained an average of 53 organisms; in September, the average increased to about 187/liter; in December, the size of the population peaked at approximately 326/liter. After a 76.8% decline in March 1974, the animal concentrations increased again to about 307/liter.

In March 1973, the benthic community at SB-B was dominated by the polychaete Exogone lourei, which constituted approximately 40% of the 2,765 organisms collected. The size of the E. lourei population decreased considerably in September, when the arthropod Ampelisca milleri appeared in very large numbers.

Environmental conditions between September and December 1973 appeared to be favorable for population growth of many species, with 11 of the 13 generally abundant species showing marked numerical increases by December. Six arthropod and 14 polychaete species, including the polychaete Polydora ligni, appeared for the first time. That month we also encountered a large number of aquatic mites, Acarina, which were absent in the two preceding sampling months and in March 1974. Tables D-1 and D-2 list the most abundant species at these stations.

2. Hunter's Point Station.

SRI found 138 different kinds of benthic animals in the sediment samples collected at the Hunter's Point disposal site. Fifty-eight

of the specimens were polychaetes, 28 were arthropods, 20 were molluscs, 11 were bryozoans (Ectoprocta), and 24 belonged to other groups such as the Protozoa, Porifera, Nematoda, Cnidaria, Nemertea, Oligochaeta, Sipuncula, Echinodermata, Phoronida, and Chordata. These animals were most abundant in September. During that month, we recovered individuals at an average of about 337/liter of sediment. About 60/liter were removed from sediment collected in March 1973; however, only about 28/liter were found in sediment collected in March 1974, the month the fewest numbers of species and specimens were collected. In December 1973 and June 1974, the average numbers of organisms per liter were 67 and 90, respectively.

The following species or groups represented 91.4 percent of the total noncolonial specimen count for this site: Ampelisca milleri (Arthropoda), Exogone lourei (Polychaeta), Mediomastus californiensis (Polychaeta), Leptochelia dubia (Arthropoda), Oligochaeta, Corophium acherusicum (Arthropoda), Nematoda and Nemertea. The arthropods were the most abundant group at this station, their numerical dominance being attributable primarily to one species, Ampelisca milleri. The high concentration of benthic organisms in September resulted from the appearance of large numbers of this amphipod that accounted for about 84% of the total number of noncolonial specimens collected.

TABLE D-1

CONCENTRATIONS OF THE MOST ABUNDANT
BENTHIC ORGANISMS COLLECTED AT SOUTH BAY STATION (SB-A)
(Individuals per Liter)

| | Percentage of Population* | Survey P (3/73) | 1 (9/73) | 2 (12/73) | 3 (3/74) | 4 (6/74) |
|---|---|---|---|---|---|---|
| Nematoda | 8.7% | 6.25 | 0.65 | 63.27 | 14.50 | 3.33 |
| Oligochaeta | 21.4 | 3.00 | 10.62 | 129.52 | 37.12 | 37.16 |
| Polychaeta | | | | | | |
| *E. lourei* | 13.4 | 5.18 | 41.34 | 29.42 | 50.48 | 8.13 |
| *H. filiformis* | 2.7 | 3.61 | 1.73 | 5.26 | 7.60 | 7.38 |
| *Sphaerosyllis* sp. | 2.2 | 0.02 | 2.02 | 4.62 | 15.73 | 0.63 |
| *P. caulleryi* | 1.8 | 0.45 | 11.82 | 1.15 | 3.62 | 0.66 |
| *S. benedicti* | 1.4 | 0.09 | 4.02 | 2.69 | 1.00 | 5.75 |
| Arthropoda | | | | | | |
| *A. milleri* | 23.2 | 3.50 | 194.38 | 1.92 | 1.78 | 22.24 |
| Acarina | 6.7 | 0 | 0 | 1.38 | 68.64 | 0.49 |
| *S. zostericola* | 1.6 | 0 | 6.61 | 4.74 | 3.69 | 1.24 |
| *C. acherusicum* | 1.5 | 0.30 | 0.42 | 0.13 | 0.26 | 13.07 |
| Copepoda | 1.3 | 0 | 0.12 | 0.77 | 12.39 | 0.34 |
| Mollusca | | | | | | |
| *T. japonica* | 6.0 | 2.57 | 4.61 | 25.35 | 4.82 | 21.95 |
| *M. senhousia* | 3.1 | 4.54 | 0.24 | 0.03 | 25.24 | 0.60 |
| Total | 95.0% | 29.51 | 278.58 | 270.25 | 246.87 | 122.97 |
| All organisms+ | 100.0 | 33.77 | 288.10 | 283,94 | 255.66 | 135.66 |

* Numerical percentage of all noncolonial organisms collected.
\+ All noncolonial organisms collected.

TABLE D-2

CONCENTRATIONS OF THE MOST ABUNDANT
BENTHIC ORGANISMS COLLECTED AT SOUTH BAY STATION (SB-B)
(Individuals per Liter)

| | Percentage of Population* | Survey P (3/73) | 1 (9/73) | 2 (12/73) | 3 (3/74) | 4 (6/74) |
|---|---|---|---|---|---|---|
| Nematoda | 3.9% | 5.48 | 0 | 28.63 | 0.09 | 1.09 |
| Oligochaeta | 13.0 | 8.87 | 1.92 | 63.24 | 28.09 | 20.61 |
| Polychaeta | | | | | | |
| *E. lourei* | 13.8 | 21.04 | 6.61 | 64.26 | 12.38 | 19.55 |
| *S. benedicti* | 7.6 | 0.06 | 2.09 | 23.30 | 3.12 | 46.48 |
| *H. filiformis* | 3.4 | 0.77 | 3.63 | 14.82 | 8.67 | 5.18 |
| *P. ligni* | 1.8 | 0 | 0 | 6.13 | 7.35 | 4.27 |
| *C. cirratus* | 1.4 | 0 | 0.24 | 10.74 | 1.36 | 1.24 |
| *Sphaerosyllis* sp. | 1.4 | 0.69 | 0 | 8.15 | 1.27 | 2.97 |
| *P. caulleryi* | 0.9 | 0 | 6.76 | 0 | 0.56 | 1.88 |
| Arthropoda | | | | | | |
| *A. milleri* | 33.4 | 4.85 | 157.02 | 10.27 | 2.25 | 148.70 |
| Acarina | 5.7 | 0 | 0 | 55.24 | 0 | 0.24 |
| *C. acherusicum* | 3.2 | 3.04 | 0.12 | 0.06 | 0 | 26.88 |
| *S. zostericola* | 1.0 | 0 | 0.27 | 3.60 | 2.07 | 4.21 |
| Mollusca | | | | | | |
| *M. senhousia* | 1.1 | 1.90 | 0.35 | 6.10 | 0.43 | 0.73 |
| *T. japonica* | 0.9 | 0.12 | 2.77 | 3.30 | 1.82 | 1.18 |
| Total | 92.5% | 46.82 | 181.79 | 297.84 | 69.46 | 285.21 |
| All organisms+ | 100.0 | 53.17 | 187.26 | 326.46 | 75.80 | 306.79 |

* Numerical percentage of all noncolonial organisms collected.
\+ All noncolonial organisms collected.

Totaling 2.0% of the benthic population, Leptochelia dubia was not particularly abundant except in September 1973. Corophium acherusicum was absent in March of 1973 and 1974; but in June, this amphipod was quite abundant (272 specimens, 9.4/liter). The most diverse group encountered was Polychaeta, of which we collected 58 species. Numerically, the polychaete population constituted about 34% of the total noncolonial organism count. Eleven of the species appeared in each survey period, but only Exogone lourei and Mediomastus californiensis appeared in significant numbers, the two making up 84.6% of the total number of polychaetes collected. A list of the more abundant species is included as Table D-3.

3. Alcatraz Station.

In analyzing this information, please recall that the Alcatraz disposal site is an established disposal site which has been used historically for many years. A total of 133 taxa were collected at this station. Unlike other areas, nearly all were considered transients except for three types which were found year-round. The three, year-round types were unidentified species of nematodes, oligochates and the bivalve Adula diegensis. It is possible that the unidentified individual species of nematodes and oligochaetes could have been transients. Transient species occur only at certain times of the year. The nemerteans, three polychaetes (Hesionura sp., Mediomastus californiensis, Polydora caulleryi), a mollusc (Macoma nasuta), and two bryozoans (Scrupocellaria sp. and Hippothoa hyalina) were present in three surveys.

Ninety-eight species were found only once during the four surveys. The Alcatraz disposal area was inhabited by more species of bryozoans (Ectoprocta) than any other area studied. Photis brevipes and the copepoda were the only types of arthropod found in September, each being represented by one specimen. Four of the 10 mollusc species were found only in September, Mysella ferruginosa being the most abundant.

The largest number of taxa was collected in December 1973 at the Alcatraz Station. The most diverse and abundant group at this time were the polychaetes, with Anaitides williamsi being the most abundant polychaete. However, the three most numerous polychaetes in terms of the total survey were not abundant in December. Thirty different arthropod species were collected and 21 of these were only found in December. Eleven mollusc species represented by 178 specimens were collected during this month.

In March 1974, the sediment collected from the Alcatraz disposal site was almost devoid of macrobenthic organisms. We collected nine species, three of them colonial types, one an unidentified species

TABLE D-3

CONCENTRATIONS OF THE MOST ABUNDANT
BENTHIC ORGANISMS COLLECTED AT HUNTER'S POINT STATION
(Individuals per Liter)

| | Percentage of Population* | Survey P (3/73) | 1 (9/73) | 2 (12/73) | 3 (3/74) | 4 (6/74) |
|---|---|---|---|---|---|---|
| Nemertea | 1.1% | 0.91 | 1.28 | 1.65 | 1.08 | 1.49 |
| Nematoda | 1.4 | 0.25 | 3.49 | 2.75 | 0.71 | 1.77 |
| Oligochaeta | 1.5 | 0.27 | 1.96 | 4.84 | 0.97 | 1.43 |
| Polychaeta | | | | | | |
| *E. lourei* | 19.2 | 27.26 | 24.17 | 18.80 | 6.73 | 26.25 |
| *M. californiensis* | 9.8 | 5.42 | 7.72 | 22.75 | 9.29 | 14.03 |
| Arthropoda | | | | | | |
| *A. milleri* | 54.9 | 21.24 | 283.17 | 1.44 | 1.24 | 15.17 |
| *L. dubia* | 2.0 | 0.99 | 7.66 | 2.16 | 0.24 | 0.94 |
| *C. acherusicum* | 1.5 | 0 | 0.32 | 0.03 | 0 | 9.44 |
| Total | 91.4% | 56.34 | 329.77 | 54.42 | 20.26 | 70.52 |
| All organisms+ | 100.0 | 60.40 | 336.99 | 66.84 | 28.32 | 90.31 |

* Numerical percentage of all noncolonial organisms collected.
+ All noncolonial organisms collected.

of Porifera, and the other two the bryozoans Electra arctica and Conopeum reticulum. The generally abundant taxa were absent, except for the nematodes (two specimens) and oligochaetes (one specimen). The sediment samples averaged 9.6 liters and did not yield a single polychaete; Diastylopsis sp. and Ischyrocerus sp. were the only arthropods present, and Macoma nasuta and Adula diegensis were the only molluscs present. These four species each were represented by one specimen.

We collected 77 noncolonial taxa in December 1973 and only 20 in June; however, the specimen count in June was about 60% larger than in December. Nine of the taxa collected in June were polychaetes. Nephtys californiensis, a polychaete represented by a single specimen, was found at this station only in June, and Adula diegensis (one specimen) and Tellina modesta (two specimens) were the only molluscs represented. We collected seven types of bryozoans, three of which - Collopora armata, Tricellaria sp., and Schizoporella sp. - were found only in June. A list showing the most abundant species is included as Table D-4.

TABLE D-4

CONCENTRATIONS OF THE MOST ABUNDANT
BENTHIC ORGANISMS COLLECTED AT ALCATRAZ STATION
(Individuals per Liter)

| | Percentage of Population* | Survey P (3/73) | 1 (9/73) | 2 (12/73) | 3 (3/74) | 4 (6/74) |
|---|---|---|---|---|---|---|
| Nemertea | 1.8% | 0 | 9.87 | 1.07 | 0 | 0.82 |
| Nematoda | 4.1 | 0 | 22.04 | 2.86 | 0.07 | 2.30 |
| Oligochaeta | 1.3 | 0 | 6.27 | 1.79 | 0.03 | 0.70 |
| Polychaeta | | | | | | |
| *Hesionura* sp. | 69.6 | 0 | 457.73 | 0.51 | 0 | 7.78 |
| *Syllides* sp. | 8.4 | 0 | 56.22 | 0.04 | 0 | 0 |
| *Streptosyllis* sp. | 7.2 | 0 | 0 | 0.17 | 0 | 44.69 |
| Arthropoda | | | | | | |
| *P. brevipes* | 0.9 | 0 | 0.04 | 6.02 | 0 | 0 |
| Total | 93.3% | -- | 552.17 | 12.46 | 0.10 | 56.29 |
| All organisms+ | 100.0 | -- | 567.29 | 37.95 | 0.24 | 58.40 |

* Numerical percentage of all noncolonial organisms collected.
+ All noncolonial organisms collected.

# APPENDIX E

## LISTING OF PLANTS, BIRDS, MAMMALS AND INSECTS IN REDWOOD CITY HARBOR ENVIRONS

This appendix was extracted directly from the Baseline Environmental Impact Statement on the Port of Redwood City area, prepared by H.K.S., Inc. (6). This list does not include rare and endangered species, listed in Table 4.

### PLANTS

| Common Name | Scientific Name |
|---|---|
| pickleweed | Salicornia Virginica |
| red pickleweed | Salicornia rubra |
| cordgrass | Spartina foliosa |
| jaumea | Jaumea carnosa |
| frankenia | Frankenia grandifolia |
| gum plant | Grindelia stricta |
| spergularia | Spergularia marina |
| saltgrass | Distichlis spicata |
| marsh rosemary | Limonium Californicum |
| arrowgrass | Triglochin concinna |
| coyote brush | Baccharis Douglasii |
| alkaline heath | Frankenia grandifolia |
| brass buttons | Cotula coronopifolia |
| pampas grass | Cortaderia sp. |
| oxalis | Oxalis corniculata |
| clover | Trifolium sp. |
| rabbitsfoot grass | Polypogon monspeliensis |
| red brome | Bromus rubens |
| wild oats | Avena fatua |
| fennel | Foeniculum vulgare |
| iceplant | Lampranthus aurantiacus |
| spurry | Spergularia rubra |
| curly dock | Rumex crispus |
| milk thistle | Silybum marianum |
| bullrush | Scirpus robustus |
| Australian saltbrush | Atriplex semibaccata |
| mallow | Malva neglecta |
| redstem filaree | Eordium circutarium |
| wild radish | Raphanus sativa |
| shortpod mustard | Brassica geniculata |
| dock | Rumex sp. |
| hare barley | Hordeum leporinum |
| fiddleneck | Amsinckia spectabilis |

| Common Name | Scientific Name |
|---|---|
| scotch moss | Sagina subulata |
| lamb's quarters | Monolepis nuttalliana |
| cocklebur | Arctium minus |
| bull thistle | Cirsium vulgarie |
| arrowgrass | Triglochin concinna |
| common knotweed | Polygonum aviculare |
| sand verbena | Abronia latifolia |
| sea fig | Mesembryanthemum sp. |
| wild barley | Hordeum leporinum |
| star thistle | Centaurea sp. |
| common groundsel | Senecio vulgaris |
| eucalyptus tree | Eucalyptus tereticornis |

BIRDS

| Common Name | Scientific Name |
|---|---|
| Forster's tern | Sterna forsteri |
| Caspian tern | Hydroprogne caspia |
| western grebe | Aechmophorus occidentalis |
| great egret | Casmerodius albus |
| snowy egret | Egretta thula |
| double-crested cormorant | Phalacrocorax auritus |
| black-crowned night heron | Nycticorax nycticorax |
| great blue heron | Ardea herodias |
| pintail | Anas acuta |
| shoveler | Anas dypeata |
| gadwall | Anas strepera |
| canvasback | Aythya valisineria |
| cinnamon teal | Anas cyanoptera |
| mallard | Anas platyrhynchos |
| lesser scaup | Aythya affinis |
| American coot | Fulica americana |
| California gull | Larus californicus |
| ring-billed gull | Larus delewarensis |
| semipalmated plover | Charadrius semipalmatus |
| hermit thrush | Hylocichla guttata |
| American avocet | Recurvirostia Americana |
| willet | Catoptrophorous semipalmatus |
| western sandpiper | Calidris mauri |
| black-necked stilt | Himantopus Mexicanus |
| killdeer | Charadrius vociferus |
| salt marsh song sparrow | Melospiza melodia pusilluls |
| marsh wren | Telmatodytes palustris |
| white-tailed kite | Elanus leucurus |
| rock dove | Columbia livia |

| Common Name | Scientific Name |
|---|---|
| morning dove | Zenaidura macroura |
| western meadowlark | Sturnella neglecta |
| house finch | Carpodocus Mexicanus |
| mockingbird | Minus polyglottus |
| belted kingfisher | Megaceryle alcyon |
| lesser goldfinch | Spinus psaltria |
| short-eared owl | Asio flammerus |
| turkey vulture | Cathartes aura |
| sparrow hawk | Falco sparuerius |
| marsh hawk | Circus cyaneus |

MAMMALS

| Common Name | Scientific Name |
|---|---|
| black-tailed jackrabbit | (Tepus californicus) |
| Norway rat | (Rattus norwegicus) |

INSECTS

| Common Name | Scientific Name |
|---|---|
| grasshopper | (Unidentified species) |
| cabbage butterfly | (Pieris rapae) |
| no-spot ladybug beetle | (Coccinella californica) |
| shoreflies | (Notiphilia sp., Hydrophrus sp.) |
| black spider | (Unidentified species) |
| red ant | (Unidentified species) |
| fly | (Unidentified species) |
| bee | (Unidentified species) |